ECOSYSTEM SERVICES, LIVELIHOOD AND WELL-BEING IN THE INDONESIAN OIL PALM BASED AGROECOSYSTEM

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Tiivistelmä — Referat — Abstract
Tutkimuksessa selvitetään öljypalmun pienviljelyn, varallisuuden sekä öljypalmun maatalousekosysteemin tuottamien ekosysteemipalveluiden vaikutuksia kotitalouksien hyvinvointiin Tanjung Beringin ja Betungin kylissä Sumatralla, Indonesiassa vuonna 2008.

Öljypalmun viljelyllä on runsaasti ympäristö- ja yhteiskunnallis-taloudellisia vaikutuksia. Erityisesti alkuperäisasukkaat ovat haavoittuva sidosryhmä laajentuvien öljypalmuplantaasien välimaastossa. Öljypalmuteollisuuden piirissä on ollut pyrkimystä löytää kestäviä toimintamalleja palmuöljyn tuottamiseen: alkuperäisasukkaiden huomioon ottamisella on tässä olennainen osa. Tutkimuksen tarkoituksena on kartoittaa tilannetta, ja selvittää öljypalmuviljelyn vaikutuksia erityisesti paikallisten alkuperäisasukkaiden hyvinvointiin liittyen, ja samalla tarjota tietoa kestävämpään kehitykseen suuntautuvan päätöksenteon tueksi.

Tutkimus perustuu kotitaloushaastatteluihin Petalangan-nimisen etnisen ryhmän alueella. Haastatteluista on koottu relaatiotietokanta, josta on tuotettu muuttujia ekosysteemipalveluista, taloudesta ja hyvinvoinnista tilastollista analyysia varten. Tilastollinen analyysi on toteutettu pääosin ristiintaulukoimalla mainittuja muuttujia suhteessa varallisuuteen ja öljypalmupienviljelijyyteen, merkitsevyys on todettu Pearssonin khii-testin avulla. Tulosten tulkinta ja analyysi on tehty ekosysteemipalveluiden (Millennium Ecosystem Assessment) viitekehyksessä.

Öljypalmupienviljelyn ja kotitalouksien tulonmuodostuksen välillä havaittiin erityisen merkitsevä varallisuutta lisäävä yhteys. Varallisuuden ja kotitalouden hyvinvoinnin välillä havaittiin yhteys: varallisuus lisäsi erityisen merkitsevästi hyvinvointia. Öljypalmuviljelyn dominoima sirpaleinen maatalousekosysteemi tuotti edelleenkin kotitalouksille tärkeitä ekosysteemipalveluita. Varallisuus vähensi kotitalouksien riippuvuutta useimmista ekosysteemipalveluista, ja sillä saatiin korvattua useiden ekosysteemipalveluiden heikentynyttä saantia. Tutkimuksen johtopäätöksenä voidaan todeta, että öljypalmuviljelyn dominoimassa maaseutuekosysteemissä öljypalmupienviljely ja parempi tulotaso vaikuttavat kotitalouksien hyvinvointiin hyvin myönteisesti, kun taas ei-öljypalmuviljelijyys ja köyhyys ennustavat pahoinvointia.

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Tiivistelmä — Referat — Abstract
This study investigates the effects of oil palm smallholding, wealth, and ecosystem services produced by oil palm dominated agroecosystem in the villages of Tanjung Bering and Betung in Sumatra, Indonesia in 2008.

The cultivation of oil palm has many environmental and socio-economic impacts. In particular, indigenous peoples are vulnerable stakeholders between the expanding oil palm plantations. Oil palm industry has sought to find sustainable models for palm oil production: the inclusion of indigenous peoples to oil palm development is an essential part of this. The purpose of the study is to chart the situation and to investigate the impact of the oil palm smallholding for the well-being of local indigenous people, and to provide information for the sustainable decision-making.

The study is based on household interviews in the area of the Petalangan ethnic group. The interviews were added to a relational database, which was used to provide variables on ecosystem services, economy and well-being for statistical analysis. Statistical analysis was carried out mainly by cross-tabulating the mentioned variables with wealth and the oil palm smallholding status, significance has been defined with the Pearson's khii-test. Interpretation and analysis of the results has been made in the framework of ecosystem services by the Millennium Ecosystem Assessment.

Oil palm smallholding highly significantly increased households' income, and wealth increased highly significantly household's well-being. The fragmented oil palm dominated agroecosystem was still providing ecosystem services to households. The wealth reduced households' dependency on most ecosystem services as well as substituted many of them. It is concluded based on this study that in the oil palm dominated agroecosystem, oil palm smallholding and higher income affects very favourable to the households' well-being, and vice versa non-oil-palm-smallholding and poverty predicts ill-being.

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ABBREVIATIONS

RSPO	The round table of sustainable palm oil production
MM	Musim Mas company
MA	Millennium Ecosystem Assessment
CIFOR	Center for International Forestry Research
NES	Nucleus Estates and Smallholders-type of palm oil production scheme
KKPA	Palm oil cooperative (Koperasi Kredit Primer untuk Anggota)
CPO	Crude palm oil
FFB	Fresh fruit bunch
RRA	Rapid Rural Appraisal
PIR	Estate-transmigration programme

1 INTRODUCTION

I am investigating oil palm (*Elaeis guineensis* Jacq.) based agroecosystem's effects to households' livelihoods and well-being in the ecosystem services framework (MA 2003). I use the Petalangan indigenous villages of Tanjung Beringin and Betung from the middle Sumatra, Indonesia as case studies. I made 64 household interviews with local families in 2008. Oil palm is a controversial crop. There are many studies concentrating to oil palm industry's adverse effects to environment (Danielsen et al. 2008; Humalisto 2006). Several NGO's have been reporting negative social and livelihood impacts (Colchester et al. 2006; WRM 2001; Amnesty International 2006). Utilisation of palm oil as biofuel has bound it to many global issues (FAO 2008) as energy policy (De Vries 2008), food security (Srinivasan 2008) and GHG-emission discussions and REDD-schemes (Germer & Sauerborn 2006; Reijnders & Huijbregts 2008). Despite many concerns, oil palm production is also seen as an opportunity to the rural people (Basiron 2007; Koh & Ghazoul 2008; Peters & Thielmann 2008; RSPO 2008; Vermeulen & Goad 2006). Socio-economic impacts are lesser extent studied, though recently there has been some improvement (Rist et al. 2010; Feintrenie et al. 2010; Gasparatos et al. 2012).

This study seeks out changes that oil palm smallholding has brought to smallholders' lives. Livelihood and well-being effects are put into context in relation with historical developments. As a result, oil palm appears to be better for households' well-being than its negative image implies. I have conducted my survey based on the rapid rural appraisal (RRA) (Conway & McCracken 1990) in the framework of the Millennium Ecosystem Assessment (MA 2003). This study is partly based on my Bachelor of Science thesis "Sustainability in the palm oil production" (Kärkkäinen 2012), but the result in hand is updated, substantially enlarged and arranged according to framework of the Millennium Ecosystem Assessment, which was lacking in the previous study made. Study was made in collaboration with the Viikki Tropical Resources Institute (VITRI), the Bogor Agricultural University (IBB), the University of Riau, and with the Musim Mas holdings (MM) that has plantations in different parts of Indonesia. Funding was provided by FORRSA-project (Forest Restoration and rehabilitation in Southeast Asia) in which IBB and the University of Helsinki were partners – FORRSA-project formed part of Asia-Link programme funded by EU

2 PALM OIL INDUSTRY

Palm oil is produced from fruits of the oil palm (*Elaeis guineensis Jacq.*), which belongs to the family of palms (*Arecacea*). It is endemic in West and Central Africa but can be now found all around the humid tropics (Röbbelen et al. 1989). Oil palm's wide global dispersal is of the human origin (Corley & Tinker 2003). It has been cultivated in Egypt already in 5000 BC. Before the early twentieth century, palm oil was traded mainly locally in Africa. During the times of the slave trade it was used as food for the slaves. Due to industrialisation, demand for palm oil begun to increase from the latter part of 1800's. Introduction of oil palm in South East Asia as an ornamental plant happened 1848 in Bogor, Java. The first large plantation for oil production was found in 1911 in Sumatra. Further development has been fast and contemporary expansion is booming (Gustafsson 2007). Currently palm oil is the most produced vegetable oil in the world.

2.1 General features

Basiron (2007) states, that the success of oil palm in South East Asia has been the favourable and humid climate without drought, which drastically reduces yields and competency of the oil palm. Oil palm is a constant year-around income source in ideal locations (Basiron 2007). The average yield of oil palm is 4.2 tonnes of oil per hectare, which is more than any other oil plant can produce (Carter et al. 2007). Palm oil is the cheapest vegetable oil in the market. According to FAOSTAT (2012) approximately 45 Mt of palm oil was produced globally, which was about 30 per cent of all vegetable oils produced altogether in 2010. Asia was producing almost 90 per cent of all palm oil. The biggest producer is Indonesia and second one Malaysia, which together produced about 85 per cent of the global palm oil. Indonesia has had plans to increase production of crude palm oil (CPO) up to 40 Mt per year by 2020 (Rist et al. 2010). Thoenes (2006) approximated that one per cent of global biodiesel produced was refined from palm oil. According to Obidzinski et al. (2012) Malaysia and Indonesia were producing close to 1 Mt of biodiesel in 2010, which was about 5 per cent of the total biofuel production in the given year. Palm oil is an export commodity, in the year 2007 Indonesia exported 70 per cent of its palm oil and utilised domestically 26 per cent for food and 4 per cent for

other uses (Stichnothe and Schuchardt 2011). As a global market commodity palm oil's production depends on international policies and market demand: world's increasing population demands more vegetable oil and energy (Obidzinski et al. 2012). Due to global demand the production has increased boomingly in South East Asia, which has caused concerns of production's ecological and social sustainability (Stichnothe and Schuchardt 2011). Utilisation of palm oil as food, oleochemicals and biodiesel has stirred a controversial global debate on the food security. Contemporary expansion of the oil palm industry is not limited only in South East Asia as companies are also expanding in Africa and South America (Sayer et al. 2012). Corley (2008) has tried to calculate the future need for palm oil and subsequent expansion requirement. According to his medium estimate global need for edible vegetable oil would be 240 Mt in 2050. The demand for palm oil would be 93 Mt – 156 Mt. The additional need over the current land would be 19 – 28 million hectares by 2050. Total cultivation area would be about 30 – 40 million hectares. For comparison, the area dedicated to forestry (metsätalousmaa) in Finland accounts 26 million hectares (Metla 2015).

Plantation sector is one of the biggest employers in Indonesia. This has led to a significant socio-economic development in the rural areas, but also a dependency on plantations as a source of employment and income (Basiron 2007). According to Gasparatos et al. (2011) about 4.5 million Indonesians depended on the country's palm oil industry. This included farmers, employees and family dependants in downstream processing and associated services. According to Sheil et al. (2009) about 2 million people worked in the oil palm sector and altogether 6 million benefitted from it in Indonesia. Indonesia earned more than US$ 12 billion of revenues in 2007 from palm oil.

There have been three main business models for oil palm cultivation in Indonesia: private large-scale plantations; combined smallholder-large-estate systems; and independent smallholders (Obidzinski et al 2012). Usually a plantation company owns the mill, which process bunches and extract the oil. In Indonesia private estates occupied 53 %, smallholders 39 % and government estates 8 % (Sheil et al. 2009). Smallholder estates' yields are generally lower than the highly managed private plantations'. Smallholders accounted one third of the oil produced Indonesia (Vermeulen & Goad.

2006). According to Rist et al. (2010) one third and according to Obidzinski et al. (2012) nearly half of the plantation area was cultivated by smallholders. The future expansion is expected to occur largely via a smallholder exchange. Indonesian government has encouraged it and calls the oil palm as “a major vehicle for rural socio-economic improvement” (Obidzinski et al 2012). Though, the mechanisms of developing oil palm industry vary: state engaged with smallholder development minimally in the Jambi province; in the resource poor West Kalimantan oil palm expansion was encouraged by the local government with beneficial terms for investors; in the Riau province oil palm was part of developmental planning to eradicate poverty (McCarthy et al. 2011).

Feintrenie et al. (2010) and Rist et al. (2010) describe smallholder schemes in Indonesia. Oil palm schemes range from few hectares smallholdings to the private large-scale estates of even 50 000 ha owned by international companies. Often plantations have a Nucleus Estates and Smallholders-type (NES) of structure wherein the company manages the refinery and estates, which are surrounded by smallholdings. The nucleus estate is referred as ‘inti’ and smallholdings as ‘plasma’. The NES-scheme is “a joint venture scheme” between a company and smallholders and often in a cooperative form. The present common NES-scheme is called as the “Primary Cooperative Credit for Members” (In Indonesian: Koperasi Kredit Primer untuk Anggota or KKPA). Usually a farmer transfers or sells some portion of his/her land to a private or government owned company and as a payment gets back an oil palm parcel. Often smallholders need to pay the initial management and planting costs. The management of smallholdings might be done by the smallholder or given to the company. Smallholders may entrust management also to a “plasma cooperative”, which may again hire the actual workforce leaving owners to enjoy the rental payments. Management can be also entrusted solely to the company in the cases where cooperative does not function well. Often initial management is done by the company because establishing a palm oil stand requires special expertise and resources. Sometimes there is no NES-scheme at all, but traditional land owners still receive constant compensation for loss of land. The NES-schemes are favourable to smallholders because through them they gain access to funding, improved seedlings and agricultural extension services, which might be crucial to succeed in.

McCarthy (2010) sees that Indonesian state and its policies have had major effects to the oil palm development in Indonesia. During the Suharto's New Order Regime (1966 – 1998) dominated a state agribusiness model in which the state oversaw rural development through the centralised political system and carried out actively agricultural extension and provided resources for rural development. Oil palm development was done by the state owned-companies with the direct state investments. After came so called estate-transmigration programmes (PIR) which were related to large-scale conglomerate firms (McCarthy 2010). The transmigration programmes moved volunteers from the over-populated islands of Java and Bali to the more sparse and remote Sumatra, Kalimantan and Sulawesi. These PIR-schemes were first carried out with rubber plantations, but later in the 1980s were applied in oil palm development. Up to mid-1990s large plantation companies (Perkebunan Besar Swasta, PBS) were common. In the PIR-schemes companies utilised huge areas of state forests and used low-cost transmigrate labour as work force (Feintrenie et al. 2010). From the early 1990s the government changed its policies towards more market-oriented direction and lesser influence on business. As a result, the KKPA–scheme is a scheme of the private agribusiness, though is still associated with the transmigration (Feintrenie et al. 2010). A firm works directly with farmers, resolve land use problems, provides extension services for plasma cooperatives and establishes infrastructure without state's involvement (McCarthy 2010).

The Roundtable on Sustainable Palm Oil Production (RSPO) tells in its internet pages that it is producer's answer to the environmental and social concerns related to palm oil business (http://www.rspo.org/). It was founded at 2004. The RSPO's objective is "promoting the growth and use of sustainable oil palm products through credible global standards and engagement of stakeholders" (RSPO 2008). It tries to find sustainable solutions to meet the rising demand for palm oil (Carter et al. 2007). The RSPO unites different stakeholders relating to the palm oil industry: producers, processors, traders, manufacturers, retailers, banks and investors, environmental and nature conservation NGOs, and social or developmental NGOs such as the WWF, Unilever and Neste oil. The RSPO (2008) has developed criteria for sustainable palm oil production and certifies producers. The certificate includes a concept of the high conservation value (HCV), which is adopted from the forest conservation. A plantation area must be evaluated by

different HCV-levels by the RSPO. According to the evaluation a company needs to produce a respective conservation plan. The RSPO demands transparency and commitment to follow national as well as international laws. Companies must produce a long-term sustainable management plan and apply the best-known methods to maintain soil fertility, water quality and minimise the use of agrochemicals. An important part of the certification is to identify all negative impacts on natural habitats, which subsequently must be treated in the management plans and operations. The RSPO wants to ensure that further negotiations with the indigenous communities are carried out in a transparent and fair manner. In addition, plantation workers must get at least industry's minimum standard wage. Replacement of virgin forest by plantations is forbidden as well as use of fire when clearing the land. All these criteria and their implementation is monitored to ensure that the companies under the certification continues to develop the sustainable palm oil production. The RSPO certified palm oil was the first time in the market in the September 2008, almost 1,5 million tonnes were expected to be produced by the end of that year (RSPO, 2008). Almost the fifth of global palm oil was certificated in the 2018 accounting 13,4 million tonnes of oil (RSPO 2018).

2.2 Specific Case of Pt Musim Mas

I refer Aksenta's audit reports for PT Musim Mas: "Musim Mas HCV Report" (Aksenta 2007a) and "Social Impact Assessment" (Aksenta 2007b). The first one tried to identify different High Conservation Values (HCV) in the plantation area and its vicinity as laid out by the RSPO. The second study concentrated on social impacts of the palm oil plantation to the local communities. These studies were part of PT Musim Mas' efforts to get RSPO's palm oil certification, which it eventually got at 2009 (RSPO 2014 and MM 2014), MM's smallholder schemes were certified in the 2010, and all Musim Mas groups' plantations were certified at the 2012 in Indonesia. Aksenta reports (Aksenta 2007a/2007b) are audit studies of a private company, not scientific peer reviewed studies, but as they offer interesting window to the point of views of a private company, they are referred in detail here.

Picture 1. View to the PT Musim Mas plantation close to the Betung village. From the travel album of Jani Kärkkäinen.

The PT Musim Mas' (MM) palm oil plantation (Picture 1) is situated in its Hak Guna Usaha (HGU) area (Aksenta, 2007a). "HGU" stands for "Cultivation right for land" and is based on leasing contract between Indonesian government and individual or legal entity such as PT Musim Mas. Contracts might be made up to 35 years with an option to additional 25 years. Pt Musim Mas is owned by Musim Mas holdings quartered in Singapore (MM 2014). Musim Mas Holdings is a privately owned global company with 28 500 employees in various countries. Its business includes the whole palm oil supply chain. Its palm oil-based products are sold to more than 80 countries across the globe.

Other plantations owned by the Musim Mas Group in Indonesia were (unpublished data from Pt Musim Mas):

- Pt. Agrowiratama (in Sumatra)
- Pt. Berkat sawit sejati (in Sumatra)
- Pt. Musim mas (in Sumatra)
- Pt. Sukajadi sawit mekar (in Kalimantan)

- Pt. Maju aneka sawit (in Kalimantan)
- Pt. Unggul lestari (in Kalimantan)
- Pt. Globalindo (in Kalimantan)

Pt Musim Mas (HGU No. 546/VI/KPR/1994) was divided into two sections of Sorek North and Sorek South (both having an oil mill) and to six estates (Aksenta, 2007a). Administratively, plantation was found on areas of four villages (desa) called Talau, Batang Kulim, Tanjung Beringin and Pangkalan Lesung in two Kecamatan's (sub-district) of Pangkalan Kuras and Pangkalan Lesung in Pelalawan Regency of Province of Riau. There existed seven major villages surrounding plantation. The total HGU area of PT Musim Mas was little bit over 28 000 ha from witch 23 000 ha (81 %) was planted with oil palm. Remaining 20 per cent of HGU included vacant areas such as swamp and swamp forest, rivers and drainage; enclave areas such as rubber and oil palm smallholdings, orchards and other communal lands of local communities, and some forested areas; and different facilities like mills, kernel crushing plant, and infrastructure like roads.

PT Musim Mas produced 135 000 t of crude palm oil and 32 000 t of kernel oil in year 2008 (RSPO 2008). These figures have been steadily rising. Annual fresh fruit bunches production capacity was 900 000 tonnes which could yield up to 247 500 tonnes of crude palm oil in 2012 (RSPO 2012).

In 2006 Musim Mas (Aksenta, 2007b) paid about Rp 1,6 billion (135 000 e according to ECB's exchange rate in 29.12.2006) of property taxes from witch about Rp 1,0 billion (84 000 e) stayed in the Pelalawan Regency. Other taxes and levies included: taxes for advertisement and road lightning as well as levies for sanitary, operating permit and disturbance permit. These yielded Rp 41,0 million (3460 e), with minimum 10 per cent allocation to the local villages.

2.2.1 KKPA-scheme

PT Musim Mas called its KKPA scheme as "a smallholders' development programme" and "act of corporate social responsibility". According to Gan (2008) it was based on

partnership with the local communities. Local farmers formed cooperative groups, which were necessary to get the third-party financing. Cooperative provided workforce and the land, which was developed to oil palm holdings by PT Musim Mas. The company provided technical inputs and agricultural extension services. Furthermore, Musim Mas guaranteed the loans of cooperatives for a bank and purchased yield and deduced debt payments accordingly.

Musim Mas had arranged two oil palm cooperatives (Aksenta 2007b), namely the Merbau Sakti and Rawa Tengkuluk, which consisted of smaller farmer groups. These included 723 parcels with area of 1446 ha. One parcel had size of 2 ha. My study area had three farmer groups which were part of Merbau Sakti, namely Tanjung Beringin, Betung-1, and Betung-2. Area of the cultivation was 102 ha in Tanjung Beringin with 51 members and 376 ha in Betung with 188 members. Average yield with groups was 2,5 tons per month of fresh fruit bunches from a hectare, which was sold to Musim Mas with price of 1200 Rp/kg earning altogether Rp 3,0 million (250 e). Monthly revenue after deductions was Rp 1,6 million (135 e) per hectare. From the parcel of size of two hectares the average revenue after the deductions was about 270 euros in a month. Deductions per hectare included (Aksenta 2007b):

Instalment to bank	Rp 900 000
Fertilizer cost	Rp 130 000
Herbicide cost	Rp 100 000
Harvesting cost	Rp 150 000
Fertilizer spread fee	Rp 50 000
Spraying fee	Rp 25 000
Total	Rp 1 355 000

According to my calculations (Table 1) based on KKPA sharing reports of Merbau Sakti from January 2006 to June 2008 there was a significant change in fresh fruit bunch yield development and income generation. In 2006 Musim Mas paid for Merbau Sakti 617 rupiahs/kg, in 2007 payment had almost doubled to 1141 rupiahs/kg and in the first half of the year 2008 it was already 1740 rupiahs/kg. Average monthly yield per hectare was 1495 kg in 2006 and 1818 kg in 2007. Musim mas began to pay additional bonus of 3 %

for smallholders from October 2007. In 2006 from all income generated, smallholders did pay back to Musim Mas 63 % where as in 2007 portion diminished to 47 per cent. Though, Merbau Sakti group did not reach the average monthly yield (Aksenta 2007b) it generated significant income. According to Dugang (2007) average monthly income was Rp 1 000 000 in 2005 in the Betung village. According to KKPA sharing reports smallholder members earned average Rp 691 000 monthly in 2006, Rp 2 278 000 in 2007 and Rp 3 660 000 in 2008. According to Aksenta (Aksenta 2007b) the value of Musim Mas KKPA programme was Rp 4 billion (337 000 e) in the year 2006 (ECB 2.6.2006: 1 e = Rp 11 873,10). According to KKPA sharing reports, after deductions, only Merbau sakti cooperative received close to 2,5 billion rupiahs (210 000 e) in 2006 and in 2007 almost 9 billion rupiahs (758 000 e). Besides KKPA-programme MM has found (Aksenta 2007b) in the villages of Tanjung Beringin, Betung and Talau so called treasury plantations. These 5 ha parcels are managed and harvested by MM, but revenues after production costs are accounted to the villages for their development. In 2006 the village treasure plantations yielded all together Rp 56 million (4700 e). The peak yielding time for oil palm happens between September and November, when almost 30 % of the annual yield might be collected.

Table 1. Revenues and costs of Merbau Sakti group between January 2006 and June 2008 based on Musim Mas sharing reports.

year	month	yield (kg)		MM Payments			Deductions				Income		
		total	/ha	Rp/Kg	bonus	total	management	loan	fertilizer	total	total pay	per/member	per/ha
2006	1	604220	938	576		348030720	185818776	104409216		290227992	57802728	179512	89756
2006	2	708280	1100	588		416468640	190165668	154190592		344356260	72112380	223951	111976
2006	3	816780	1268	609		497419020	200152427	178475706		378628133	118790887	368916	184458
2006	4	1042090	1618	570		593991300	212790164	178197390		390987554	203003746	630446	315223
2006	5	1083430	1682	579		627305970	210762247	188191791		398954038	228351932	709167	354584
2006	6	1028910	1598	612		629692920	165516819	188907876		354424695	275268225	854870	427435
2006	7	846980	1315	601		509034980	83173736	152710494	86067450	321951680	187083300	581004	290502
2006	8	1061890	1649	659		699785510	102561076	209935653	86067450	398564179	301221331	935470	467735
2006	9	1248980	1939	667		833069660	119389776	249920898	86067450	455378124	377691536	1172955	586478
2006	10	843910	1310	648		546853680	82971476	164056104	86067450	333095030	213758650	663847	331923
2006	11	1304750	2026	682		889839500	124418796	266951850	86067450	477438096	412401404	1280750	640375
2007	1	921810	1431	874		805661940	93435053	241698582	141803460	476937095	328724845	1020885	510442
2007	2	940470	1460	877		824792190	94825258	247437657	141803460	484066375	340725815	1058155	529077
2007	3	1028140	1596	908		933551120	103145308	280065336	141803460	525014104	408537016	1268748	634374
2007	4	1083930	1683	995		1078510350	108331933	323553105	141803460	573688498	504821852	1567770	783885
2007	5	1059400	1645	1143		1210894200	106242848	363268260	141803460	611314568	599579632	1862049	931024
2007	6	1016040	1578	1234		1253793360	96922247	376138008	26992151	500052406	753740954	2340810	1170405
2007	7	1061410	1648	1178		1250340980	112100273	375102294	143796610	630999177	619341803	1923422	961711
2007	8	1301200	2020	1251		1627801200	129507538	488340360	143796610	761644508	866156692	2689928	1344964
2007	9	1443220	2241	1221		1762171620	141255045	528651486	143796610	813703141	948468479	2945554	1472777
2007	10	1457960	2264	1269	73247949	1923399189	142477474	555045372	143796610	841319456	1082079733	3360496	1680248
2007	11	1391610	2161	1377	76649879	1992896849	137068911	574874091	143796610	855739612	1137157237	3531544	1765772
2007	12	1347830	2093	1369	73807171	1918986441	133366174	553553781	19949093	706869048	1212117393	3764340	1882170
2008	1	1228400	1907	1624	74702701	2069624301	123617150	598476480	306005030	1028098660	1041525641	3234552	1617276
2008	2	1147250	1781	1739	77930155	2072997905	115536662	598520325	306005030	1020062017	1052935888	3269987	1634994
2008	3	1109370	1723	1858	82448378	2143657838	112738601	618362838	306005030	1037106469	1106551369	3436495	1718247
2008	4	1123540	1745	1665	71020242	1941714342	117437697	561208230	306005030	984650957	957063385	2972247	1486123
2008	5	1174950	1824	1813	81387564	2211571914	120774026	639055305	306005030	1065834361	1145737553	3558191	1779096
2008	6	1334250	2072	1740	89047632	2410642632	127805013	696478500	181468610	642814903	1767827729	5490148	2745074

Pt Musim mas plantation had effects also to some villages (Aksenta 2007b), which were further away from its exact HGU area. Villages of Air Hitam and Lubuk Kembang Bunga had their shifting cultivation sites in the current area of HGU. This had led to some demands from these villages to get Musim Mas cooperatives to these villages as compensation from their losses. However, from the MM point of view villages are so far away from production facilities, that it would not be economically feasible to establish any cooperative. The Kesuma Village was one of the six villages in which Pt Musim Mas agreed to develop oil palm smallholdings in 2004, and the only one where this was not succeeded. What follows is summarised from the unpublished internal report of Musim Mas about the Kesuma Case (Musim Mas 2008). According to MM (2008) the basic condition for agreement to establish a KKPA cooperative was that the villages could provide legally and agriculturally suitable land, which company would then develop to oil palm smallholdings for the villagers. Suitable land should be undisputed land, without any third party or stakeholder claims. Company would be responsible to develop smallholdings according to land provided by the villages, but no more than 300 ha. If any land disputes would arise with other stakeholders, it was responsibility of the villagers to resolve them. Agronomical suitability was studied by the MM survey team: it included such features as soil quality, accessibility for transportation and employee mobilisation. If provided land were not accepted by survey team, village could propose other sites. Membership requirement for an individual participant was nativity in the cooperative village. Up to year 2008 other five villages had provided altogether 1480 ha of land which was already producing yield. However, Kesuma was not able to comply the requirements. The land first proposed was subject to flooding and hence unsuitable for development. After few years other site was offered, but it was found to be deep peat, which is not suitable for cultivation and its conversion would have been also against legal regulations. Furthermore, other site was proposed, but now it was forest and under lease with PT. Arara Abadi as a concession land, and again illegal to convert. Afterwards other land was again proposed, but it was found to be customary right land of Monti Rajo of Betung. After continuous disappointments situation escalated between people of Kesuma and Pt Musim Mas in a conflict where hundred villagers arranged demonstration and prevented MM workers from working in the actual plantation. They also fenced 300 ha of land in the HGU area of Musim Mas demanding that it would not be released until their village land would be developed by MM. The head of the local

police and military were required to resolve the situation, afterwards conflict remained unclosed.

According to Aksenta (2007b), members in KKPA cooperatives or in village administration did not understand enough the management scheme or financial issues. Aksenta (2007b) saw that this was due to low level of education. MM extension functioned with cooperatives but was faced difficulties when teaching proper management practices and how the finance and credit scheme functions. Continuous capacity building was required, and technical assistance could not be ceased after initial phase of cultivation. Financial management was controlled by MM, which has made cooperatives dependable from MM management and extension teams.

2.2.2 Indigenous population

PT Musim Mas' plantation was founded on traditional lands of the Petalangan ("people of bamboo") ethnic (Chou 2006). Size of the ethnic was about 30 000 habitants in Pelalawan Regency in 2006. They considered themselves as Melayu or Malay and were furthermore divided to several clans (suku). Effendy (1997) tells that the Petalangan or the Orang Talang used to be very depended of their natural surroundings. Traditionally the Petalangan used to live in the forest or riversides (Aksenta 2007b).

Last Sultan of the Pelalawan Kingdom surrendered in 1945 to the Republic of Indonesia and henceforth Petalangan area was incorporated into this recently formed state. Transition from a colony to an independent state was not especially favourable to the indigenous communities in Indonesia (Effendy 1997). Consequently, the traditional Petalangan communities lost their autonomy and territories. Tribal areas (kedatuan) formerly led by Sultan's appointed Monti Rajo (king's minister) were transformed to sub-districts (e.g. Kecamatan Pangkalan Kuras). Clan based territories (pebatinan) led by Batin were changed and some cases divided into new administrative units called desa (village). The traditional elder's adat-councils were replaced by village councils. Traditionally a Batin was responsible to handle all land-related issues under his territory. Now they were replaced by the village heads (kepala desa) and the rights to Petalangan

natural resources and their administration was given to these new representatives of the government, which were often outsiders since local people could seldom read or write. However, Batins still maintained their position as cultural figures. As a result, there has been disputes between traditional and official village heads about the land rights (Chou 2006). According to traditional rules only settlement and plantation type smallholdings could be inherited or sold as personal property, whereas other agricultural lands with paddy and forest remained property of the community but could be managed by individuals (Aksenta 2007b). Inheritance right was matrilineal, but if land was sold, profits were shared to male descendants. Effendy (1997) stated that still in the end of 90s' some Petalangan people did not understand governmental regulations or state's claim to the land. Some people were convinced that land rights affirmed by the Sultan of Pelalawan were still valid. Problems arise when the state issued HPH-licenses (Hag Penghutanan) for companies to harvest or use the forest on the traditional Petalangan areas.

Although, natural surroundings of Petalangan were deteriorating, and they had beginning to abandon their traditional way of life (Effendy 1997), the traditional adat-law was still acknowledged during my field work period in 2008. The village chief of Betung, Mr. Dugang (2008) told that in his village traditional rules were still respected in all their activities: in marriage ceremonies, agricultural practices, behaviour, table manners, and with the Sialang trees. Adat was followed also when choosing Batin or if conflicts happened. Usually conflicts were first tried to solve traditional ways and if that failed, official government and its regulations were applied. The Petalangan customary adat-law reflects close relationship with the nature (Effendy 1997) and used to regulate how the Petalangan imagined world around them and how they classified their environment (Chou 2006). Petalangan territory was divided into four categories by function: village land (*Tanah kampung*), orchard land (*Tanah dusun*), swidden land (*Tanah peladangan*) and prohibited forest or jungle (*Rimba larangan*). The village land was a land along the river for homesteads and villages. Orchard land was considered as extension of the village and could be utilised as growing so called strong plants (*tanaman keras*) as jackfruit (*Artocarpus heterophyllus*), durian (*Durio* sp), rambutan (*Nephelium lappaceum*) and rubber (*Hevea brasiliensis*). Swidden land was utilised by dry-rice farms in rotation of five to ten years. Swidden area was not expanded randomly but was

allowed only in the certain demarcated areas. Aksenta (2007b) adds that there were at least two different types of forest: 1.) reserved forest or natural refuge (*Rimba Simpanan)* provided several important non-timber products such as rattan, resins, game and house timber; 2.) forests with *Kepung* beehives (*Rimba kepungan sialang*) were source for many fruit varieties such as durian, lansium fruits and jackfruits, and wild honey. *Rimba kepungan sialang* was in especial protection by Batin. If a Petalangan would damage these forests he could be fined or even banished. Sialang trees were still especially important cultural and spiritual symbols since they were symbolising the whole cosmos and human body. To collect honey a special wooden instrument (symbolising the back bone) was used and ceremonies were carried out while chanting mantras (Chou 2006). According to Effendy (in Chou 2006), forest was not only the source of subsistence to the Petalangan, but "the source and symbol of their very life and identity". Separating a Petalangan from the forest used to be as "to wrench their souls from their bodies" (Chou 2006).

Some MM's plantation's enclave areas were highly important for local's traditions, religion and culture – namely cemeteries, hot springs and Sialang trees. If company transplanted seedlings too close to a certain sacred tomb or the old cemetery, locals cleared seedlings off. Sites with hot water springs were used by locals as spiritual resorts. Locals believed that water from these springs had therapeutic or medicinal effects and custom was to leave wet clothes on after bathing. The Kebung beehives consisted small patches (altogether 4-5 ha) of natural forest inhabited by bees.

2.2.3 Surroundings

Villages of Tanjung Beringin and Betung were situated in the District of Pangkalan Kuras in Pelalawan Regency of Riau Province, Sumatra, Indonesia (Figure 1). Sumatra was providing about 80 % of total Indonesian palm oil production, which was more than one third of the global palm oil production in the 2010 (Rist et al. 2010, FAOSTAT 2012). Province of Riau was developing fast as a massive industrialisation were on-going: Riau, Singapore and Johor formed so called growth Triangle (Chou 2006). In the rural settings people were still living in relatively poor conditions. The Pelalawan regency had been target of transmigration programmes, in the years 1987 – 2006 area received more than

50 000 migrants (BAPPEDA 2006). Major agricultural crop in the regency was oil palm, accounting 76 % of all area utilised for plant production, next was rubber with 10 per cent portion. About 30 % of the oil palm and nearly all rubber area was managed by smallholders. In addition, Pelalawan regency was a livestock exporter to other regencies in Riau province. Pelalawan Regency was divided into 12 districts, in which Pangkalan Kuras was one. From the total land area about 40 % were under plantations and different money crops (oil palm, rubber and coconut), from witch oil palm accounted 90 % (BPS 2006). Oil palm accounts 37 % (45 000 ha) of the total land area of the district of Pangkalan Kuras. Half of the area was still categorized as production or other type of forest (BAPPEDA 2006, Kabupaten Pelalawan 2006). Other food crop production and infrastructure accounted 10 % of the total area.

Figure 1. Map of the study area shows location of Betung and Tanjung Beringin villages, northern area of Pt. Musim Mas plantation (inti) and its KKPA parcels of Merbau Sakti group (plasma). Also visible are locally important rivers of Nilo (western side of MM plantation) and Napo (traversing the MM plantation). Map is based on GIS-info provided by MM but drawn by me. At the background map of Indonesia.

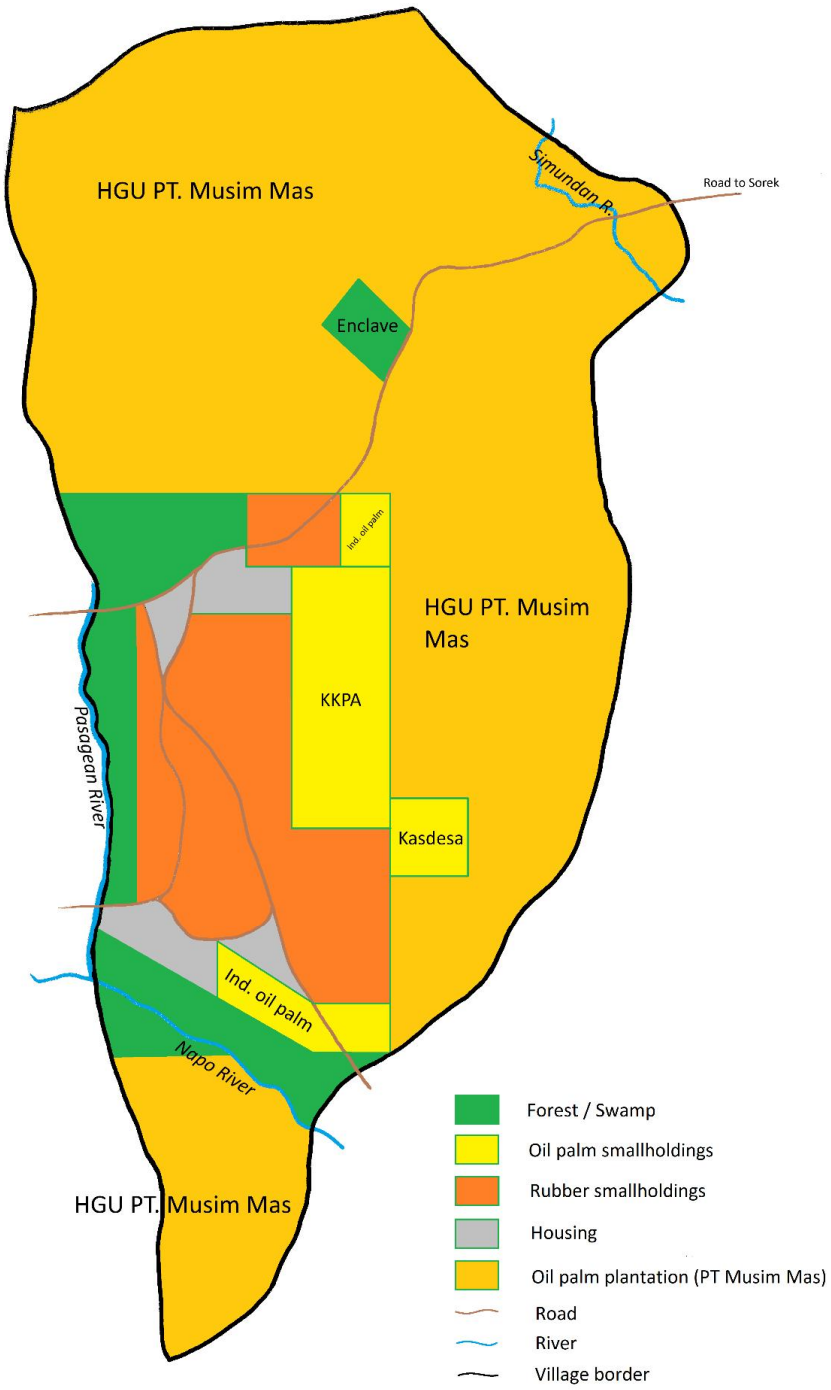

Figure 2. Land use map of Tanjung Beringin. My drawing is based on a map made by local village officer on map provided by departmental office of Pangkalan Kuras.

Tanjung Beringin

Tanjung Beringin (Figure 2) was moved to its current location by the Musim Mas Company during the process of forming plantation (Aksenta 2007a). Aksenta (2007b) is calling Tanjung Beringin as an enclave village since it was surrounded by the Musim Mas

plantation. It accounted 17 km^2. In the administrative area of the village lived 304 households with the total population of 1022 habitants in the year 2007 (Aksenta 2007b, Camat Pangkalan Kuras 2008.). However, this figure included also 250 family heads, which were employees of Pt. Musim Mas and might be staying in Musim Mas housing areas in the plantation. In the actual core village there were residing about 65 families (Picture 2) according to Aksenta's survey (Aksenta 2007b). Administrative village formed only one cluster (Camat Pangkalan Kuras 2007). Since access to the village was restricted due to rough roads, inhabitants had tended to move other villages, with better access options. The primary sources of income included rubber and oil palm farming, and fishing. Tanjung Beringin was very dependent of the close river, which was major source of protein for the local inhabitants (Aksenta 2007b). Total extent of oil palm cultivation area in the village is difficult to define because of inconsistencies in sources, according to village profile (BPMD 2005a) the plantation land accounts 250 ha (15 %), but oil palm area only 20 ha, whereas according to Aksenta (2007b) KKPA area was 102 ha. In addition, there is no knowledge of which quantity of original village area is now under MM plantation.

Picture 2. Houses in Tanjung Beringin. From the travel album of Jani Kärkkäinen.

Betung

Betung (meaning a large bamboo) used to be surrounded by untouchable jungle, but in 2007 there remained only 120 ha of old forest or Sialang encirclements (Figure 3) (Dugang 2007). The Betung village was located outside the Musim Mas plantation, though, small portion of the village were included in its HGU area (Aksenta 2007b). Betung consisted of 50 km^2, which was administratively divided to three clusters (Camat Pangkalan Kuras 2007). According to Central Bureau of Statistics of Pelalawan (BPS 2006) there were 1267 inhabitants in 302 households in 2006. Twenty per cent of the population were migrants (Dugang 2007).

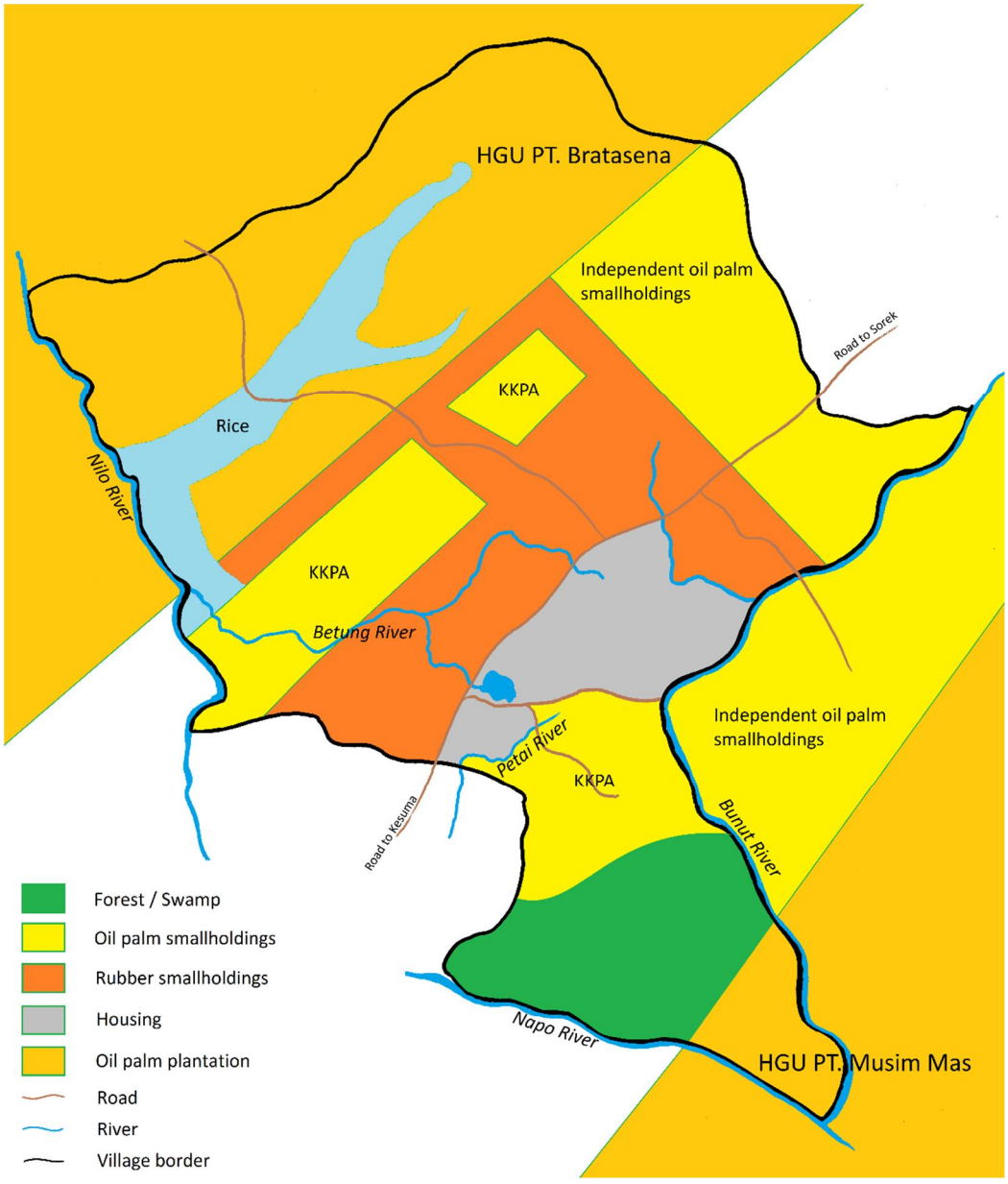

Figure 3. Land use map of Betung. My drawing is based on a map made by local village officer on map provided by departmental office of Pangkalan Kuras.

Betung was relatively easy to reach through asphalted roads, though no public transportation existed. Like Tanjung Beringin also Betung depended on the close river. Major sources for livelihood were fishing, rubber tapping and oil palm plantations. Logging was not possible anymore and other forest related income sources had been declining. Also shifting cultivation was not anymore practised due to lack of suitable land. Village administration had cooperation with Pelalawan regency to develop irrigated agricultural schemes. According to village profile (BPMD 2005b) 4000 ha were under private oil palm ownership and 1350 ha under smallholders, which would together fill the whole area of the village, which does not seem to be right if not village area is considerably larger than mentioned by Aksenta (2007b) and Dugang (2007). However, considerable portion, maybe two thirds of the administrative area of the village, seems to be under oil palm cultivations. Betung was culturally important site for the Petalangan since their traditional leader *Monti Rajo* resided there (Aksenta 2007b). There existed also Petalangan cultural centre (Picture 3) where traditional leaders gathered to discuss communal issues, land disputes and other traditional issues.

Picture 3. The Petalangan cultural centre in Betung. From the travel album of Jani Kärkkäinen.

Geography and land use schemes

Landscape close to the study villages was somewhat undulating, but not very high in altitude. For example, Sorek reached the altitude of 35 metres from the sea level (BAPPEDA 2006). Hydrologically the study area was the river basin of the Kampar River (Aksenta 2007a). Locally important streams were the un-drying rivers of Nilo (width 10 – 25 m) and Napo (width 4 – 6 m). Climate was tropical: about 130 raining days per year with the rain intensity about 190 mm per year; the average air humidity of 84 % was quite constant; average annual temperature was 26 °C. Soils of the area consisted mainly from gleisols and organosols. There could occur very high erosion of 250 – 1000 ton/ha/yr. on the medium-steep slopes around the MM's HGU areas (850 ha), but majority experienced moderate erosion of 20 – 50 ton/ha/yr. HCV report (Aksenta 2007a) could identify in the HGU area presence or traces of 25 mammal species, 50 bird species, and 18 reptile species. Landscape was a mosaic of local's communal lands and plantation areas (Aksenta, 2007b). PT Bratasena and PT Musim Mas were closest and the most important plantations from the point of view of study villages. Betung were situated between the areas of these two companies, whereas Tanjung Beringin was surrounded by PT Musim Mas. Village of Betung and their communal lands were situated in the north boundaries of PT Musim Mas Plantation. Sorek was the most important market for local habitants, and source for their daily needs, though wealthier could go up to Pelalawan or Pekanbaru. More northwards begun HGU areas of PT Surya Bratasena and PT Serikat Putra. Capital city of Pelalawan regency, Pangkalan Kerinci was about 50 km north from the study villages. Southside were PT Indo Sawit, and some community plantation areas. Westward occurred mainly cultivated lands or degraded forests and forest plantations of PT Arara Abadi. About 20 km west were the nearest natural reserve area, the Teso Nilo National Park. Pangkalan Lesung were east side of the MM plantation. Major part of the MM's HGU area was not actually in the side of Pangkalan Kuras district, but in its neighbour district of Pangkalan Lesung. In Pangkalan Kuras PT Bratasena occupied larger area.

3 LIVELIHOOD, WELLBEING AND OIL PALM

3.1 General notions

Feintrenie et al. (2010) states that Indonesia is facing an agrarian transition in which an agricultural and rural society is turning into “a more urban and industrialized one”. However, urbanisation is not the only direction of transition as in some areas traditional livelihoods are abandoned and the agrarian way of life is adopted. Feintrenie et al. (2010) and Rist et al. (2010) have charted some differences in livelihood before and after the arrival of oil palm in various districts in Indonesia. Before the rural peoples’ livelihoods depended on rice cultivation for self-consumption and rubber as source of income. Also, different agroforestry schemes were practised. Traditional sources of income included collection of different non-timber-forest-products (NTFP) combined with shifting cultivation, but these provided usually mostly for subsistence. Nowadays even logging does not provide regular income source. As forests are diminishing, importance of these activities has been declining. Currently rubber and sometimes rattan agroforestry systems may create some surplus income, but opportunities to expand production are limited due to lack of capital, land, time and labour. As there are not many income sources in the countryside logging companies, coal miners and oil palm developers have been offering some major prospects for the people (Rist et al. 2010). In the Indonesian occasion oil palm and rubber complements each other in smallholder schemes (Feintrenie et al. 2010): oil palm can be harvested year around, latex collection is usually done during the dry season. Oil palm is also fast maturing: first harvest can be made in a third year after planting whereas with rubber agroforest systems immature period can last up to 10 – 15 years (with clonal rubber 7 years). Besides source of money, palm oil can be a direct source of energy. In the tropical and subtropical region, it may be utilised as a cheap fuel for home generators to produce electricity (Carter et al. 2007). According to Gasparatos et al. (2011) palm oil’s utilisation as biofuel might increase energy security in national but also local scale. Palm oil as biofuel might be much more convenient source of energy than firewood because wood has very high shadow cost due to the amount of time and labour invested to collection.

According to Rist et al. (2010) oil palm has been "a source of significant livelihood improvement for many rural communities". Among the oil palm smallholders, proportion of poor people has been decreasing and in Malaysia being even non-existent since the early 1980s. Sadker et al. (2007) has noted significant improvements in household incomes (60 % – 150 %) because of oil palm development. Rist et al (2010) compared the profitability of the main local agricultural systems (oil palm, clonal rubber, rubber agroforestry and inundated rice) in Bungo District, Sumatra. During the high prices clonal rubber gave the highest yearly return to land (3590,48 $/ha), but oil palm gave highest return to labour (47,33 $/person/day). In other words, oil palm is less labour intensive than rubber. Inundated rise (264,51 $/ha) could not compete as a source of income with rubber and oil palm. In addition, oil palm is a relatively labour demanding crop, which can function as a vector for spreading capital to a wider population (Corley and Tinker 2003). Although, oil palm can be relatively good source of income, unstable palm oil prices (which are tied to global fossil fuels) and rising commodity prices might cause problems (Rist et al. 2010 and Feintrenie et al. 2010). After July 2008 FFB producer price fell gradually from 1500 Rp/kg to 600 Rp/kg. This had crucial effects to smallholders' solvency and profits. Before the fall typical arrangement for two hectares smallholding upkeep was a loan of 15 million Indonesian Rupiah (1470 $), an interest rate of 14 % and a reimbursement of 30 % of monthly net income with repayment beginning in the 5th year of planting. With these terms during the good oil prices, debt could be paid in six years, but with constant low prices in 18 years. In this case prise price drop was not a permanent one and according to Rist et al. (2010) oil palm smallholders fared better than the solely rubber growing farmers and recovered faster. Gasparatos et al. (2011) argues, that oil palm cultivation competes with food production and pushes other food crops to other areas. This might add to rising food commodity prices. On the other hand, rising prices might increase income of farmers, but leave those without cultivation land in a worst situation.

Higher income level makes possible to acquire household goods; enables greater access to education (afterwards many natives have returned as public servants like schoolteachers); and better health care (Feintrenie et al. 2010). According to Rist et al. (2010) land is often the only asset of locals even though their rights to it maybe only informally recognised. When a traditional landowner considers releasing his land to the

oil palm development schemes, regular and relatively high income from smaller oil palm plot is considered more valuable than having a lot of land without income generation. According to Rist et al. (2010) farmers or communities tend to exchange their less productive or remote lands, and former sources of income are seldom replaced. Oil palm is often considered as complementary to the other sources of income. Smallholders like to cultivate more intensively close to the home or village than less intensively far away in a larger area. A farmer spends labouring with oil palm two days per month, whereas with rubber 14 days of labour per month. In those parts of Indonesia where land is abundant, returns to labour have the greatest influence on decision making when choosing what to cultivate. (Rist et al. 2010)

Rist et al. (2010) found out that generally locals were quite eager to adopt oil palm. Often villages compete companies' attention and investments. Attraction of the oil palm is considerable in the places where already exists perennial cultivation of rubber or other agroforestry (Feintrenie et al. 2010). Mixed oil palm and rubber cultivated landscape seems to be desired state of environment for many. Deforestation or decreased biodiversity does not seem to be concern for the locals. Rist et al (2010) found out that the most unwilling communities towards the oil palm were those which did not had much experience of cash crops and which were mostly dependants of the forest. History could have made these more remote smallholders cautious: Suharto regime was often unfavourable to the local smallholders and after its fall in 1998 the 'reformasi' period strengthened communities' ability to resist land development. In some areas the presence of various palm oil companies may allow considerable bargaining power to the locals. According to Rist et al. (2010) local people want development, but still value also the services and goods from forested landscape.

Feintrenie et al. (2010) has found that a functioning cooperative is crucial for the successful results. An important factor to functioning smallholder scheme is how well managers of smallholders' cooperatives can play their part: if a manager is passive and seas personal advancement and bribes more important than common good, gains from oil palm might be poor. (Rist et al. 2010). Also, the shared responsibility of oil palm management with company was generally seen favourable: companies offer inputs for exchange of land to overcome initial starting costs; oil palm requires large investments

for quality seedlings, fertilizers, and careful management (McCarthy 2010). Some smallholders criticised planting and management costs to be too high resulting high levels of debt. These complaints seemed to fade after few years of management and when oil price was favourable (Rist et al. 2010).

According to Obidzinski et al. (2012), Rist et al. (2010) and Sayer et al. (2012) most negatively affected stakeholder groups were the former landowners and customary land users, especially those members of the community who were left out of the oil palm scheme. Households that relied on forest resources on income and food needed to seek other sources for subsistence. Logging and sawmill activities were abandoned due to decreasing forest resources. Those who still owned land begun food-crop farmers and those without land seek off-farm activities like construction. Negative livelihood impacts were related to the loss of income derived from forest; degradation of environment; concerns over land speculation; and rising price of land, which restricted the smallholders to enlarge their cultivation area; and socio-economic conflicts between the indigenous population and emigrants. Trans-migrants have often feared better as farmers as well as labourers due to be more capacitated to cultivate oil palm than the indigenous people (Sayer et al. 2012). As a result, wealth might have accumulated more for the newcomers than to the locals. KKPA schemes have tried to include more local population to palm oil development, but again with varied results (McCarthy 2010). Rist et al. (2010) found that even where development schemes where similar, livelihood outcomes were divergent. Some smallholders tend to sell their land to companies at the cost of subsistence, in other words did not leave adequate amount of land for food production. Some farmers lack endurance to cultivate their oil palm plots and gives up after few years of management before the most productive agricultural period. Reasons to this might have been cost of fertilisers or dislike of living in a new plantation village far away from the relatives. After returning these farmers might have faced additional problem: they had no land anymore to support themselves.

According to Rist et al (2010) most controversies related to oil palm expansion were relating to “the clarity of the contracts signed with companies, weak local governance, the failure of companies to meet either contractual or perceived obligations, lack of clarity over land tenure prior to plantation development and changing land values”.

Often farmers had not or could not read contracts they signed or could not understand the "agreement language". They relied more to the spoken word and verbal agreements. Though, the agreement text itself might lack some important aspects. For example, it has been common that it is not well defined what happens to the land exchanged to the company after 25 years of cultivation cycle – who retains the ownership? Smallholders might have general uncertainty about the ownership of land and terms of debt payment and amount. Local government officials usually favour the oil palm expansion because it brings more tax money, which can be used for community development (sometimes also bribes and personal advancement). In result land use agreements might be hastily done without sufficient participation with the local people. Local official might have leased the so called traditional common lands to an oil palm company or to trans-migrants without consulting not-that-willing local people. In some occasions part of the community has sold land to a company without consulting the rest. When a conflict arises between community members, it has been easier to blame a private company than their own kin and co-villagers. Colchester et al. (2006) discuss problems related to the law and the land acquisition in Indonesia. Landownership is difficult to measure in Indonesia. Presence of two different legal systems causes problems: the customary *adat* law and the official state law. The state law is same throughout Indonesia whereas *adat* varies according to the area and indigenous group. The state law is written whereas *adat* law remains unwritten. According to the state law, the state has right to issue or revoke the land ownership. But generally, the *adat* can only give right to utilise certain piece of land, but not to own. Indigenous communities generally respect both laws, but maybe not clearly understanding the state law. Also, the Constitution of the Republic of Indonesia recognises the *adat* law in the *adat* regions. As a result, there are misunderstandings between the oil palm companies and the *adat* communities (Colchester et al. 2006). Legal situation remains problematic not only for the customary communities but also for the oil palm companies. Now companies do a double payment: rent a land from the government and after that pay to the communities for utilisation (Gan 2008 personal communication). Sometimes customary law might be quite flexible to the whims of *adat* leaders. It might be easy for companies not to take account customary rights, but if companies want to respect them, it might be equally difficult.

Rist et al (2010) found that companies and local government officials made often promises that they did not held. It was common that companies did not fulfil promised community agreements, for example schools or clinics were not constructed or technical assistance with plantation management was not given. Feintrenie et al. (2010) gives an example from an oil palm transmigration project from Sumatra. Villagers from Sungai Teleng agreed to take part with the project and received migrants from Jakarta. Together they were to participate in NES-scheme. However, the company never arrived. Later, land shortages created tensions between the natives and migrants. Obidzinski et al. (2012) states that, plantation development commonly lags for years or decades after initial acquisition of the land. As an example, in the islands of Sumatra and Kalimantan more than 11 million ha was earmarked for the oil palm, but less than half of it was developed into plantations. Sometimes forest is over logged to get funds for plantation development, but then plantation does not realise at all. Land sold to the company in the early phase of plantation development is often significantly cheaper than when sold after some years of development and infrastructure changes, which tend to raise land value (Rist et al. 2010). Those farmers who sold their land in early phase might feel cheated compared to those who are selling later with higher price. Colchester et al. (2006) lists human rights violations: customary rights not recognised; plantation established without government license; information not provided to communities; consensus agreements not negotiated, customary leaders manipulated into making forced sales; compensation payments not paid; promised benefits not provided; smallholders lands not allocated or developed; smallholders encumbered with unjustifiable debts; environmental impact studies carried out too late; lands not developed within the stipulated period; community resistance crushed through coercion and use of force.

Plantation management causes leaching of nutrients and chemicals to water ways, and mills causes air and water pollution, and increased intervals of forest fires correlates with respiratory diseases (Wicke et al. 2011). Increased rat populations' harms adjacent rice farms and can carry diseases (Rist et al. 2010). Also, odours from the refinery might be unattractive to the locals (Feintrenie et al. 2010). According to Obidzinski et al. (2012) villagers living near to the plantation might suffer air pollution because of burning the oil palm waste. Obidzinski et al. (2012) reported increased amount of crop pests and

various skin diseases, and due to significant use of pesticides and herbicides river water turned unusable at one site. Sheil et al. (2009) reports various complaints about the quality of river water, which decreased after founding a plantation and furthermore suggest that consequently one can find heavy metals from the river fishes influenced by plantations.

McCarthy (2010) discusses how social, political, and market processes associated with palm oil have influenced the rural population. There are two contrasting point of views, which McCarthy (2010) starts with. First is that of the World Bank: "dynamic and efficient agribusiness spurs agricultural growth" which leads to reduced rural poverty: rural people from remote, uneconomic and degraded areas can get access to global markets and its economic benefits. Second is the less optimistic perspective of some NGO's and social movements'. They associate agribusiness-dominated "agriculture-for-development" as dependence of an exclusionary corporate agriculture, which creates "new social vulnerabilities, increasing pressure and competition for land, and further weakening the relative position and food security of the most vulnerable rural actors" (McCarthy 2010). McCarthy (2010) argues that changes associated with the oil palm expansion are very complex and highly variable depending on different factors. These factors include such key issues as: whether there exist a smallholder development scheme and how the scheme is implemented; what kind of role state has taken in the local area; the degree villagers control local village institutions and practices; how oil palm has been received by locals in an already differentiated agrarian landscape and what changes it has caused in their livelihoods practices; and land tenure systems with informal land markets. According to McCarthy (2010) pro-market stance cannot be easily combined with pro-small farmer approaches. Absence of the state, international donor agencies and wider civil society might lead unsustainable results. Although, legally oil palm development in Indonesia is regulated, the deals offered by companies to the communities differ considerably. McCarthy (2010) sees that local people might have little resources to affect to the wider agrarian change. Current lesser state's influence in the process might leave peasants at the mercy of market powers. As oil palm agriculture requires high initial capital, it may constrain people's possibilities to participate in the oil palm expansion. There are also natural obstacles in topography, logistics and infrastructure, which have directed palm oil expansion in rural settings. This has led to a

formation of so-called “sleeping areas” between oil palm developed areas. People of these sleeping areas might be vulnerable to penetration of land buyers because not understanding correct value of their land or impacts of the palm oil expansion to their livelihoods in general. McCarthy (2010) claims that, oil palm causes significant differentiation of people, because wealth from it does not spread evenly. Historically state promoted agrarian change was trans-migrant centred. In many places, there has occurred friction between the new comers and indigenous people. Furthermore, change from “autonomous farming to a market dependant livelihood” might have significant impacts to local culture. Some locals consider moving out of farming as improvement of social status: modern life and urban comforts are something to worth pursuing (Feintrenie et al. 2010). Refineries and plantations provide working opportunities which are considered as improvement of the social status if not economic well-being. Usually the company workers enjoy accommodation, school busses, and better medical care. Besides these advantages majority of the local people tend to favour village life over living in the core plantation: in the village people have their family and social relations which might be lacking in the plantation.

3.2 Specific notions with the Petalangan indigenous group

According to Aksenta (2007a), major land use changes in the HGU area of PT Musim Mas begun at the arrival of the logging company of HPH PT Limbang Mutiara during the 1970s. Towards the end of the 1980s land was first time opened for private large-scale plantations to grow oil palm (Effendy 1997). Pt Musim Mas was founded in 1994 on area utilised before by PT Limbang Mutiara and PT Arara Abadi, an Acacia plantation company. MM begun to convert these degraded forests in accordance with provincial development plans. The provincial government of Riau has decreed some restrictions towards companies to protect some valuable indigenous areas, such as the village gardens, cultivated lands and forests around Sialang trees (Chou 2006). According to Effendy (1997) national government has also recognised need for rural development. Petalangan sub-districts were categorised as poor or very poor areas with alarmingly low income. One intention of government in opening Petalangan areas for land use development and oil palm has been poverty alleviation.

HCV report (Aksenta 2007a) states that composition and population of flora and fauna of the PT Musim mas HGU area was mostly unnatural. Landscape was dominated by vast plantation areas, which were broken only by roads, rivers, degraded natural land covers, and other cultivation areas. Vegetation were dominated by oil palm, acacia and rubber. Some damaged natural habitats still prevailed along riversides and swamps not planted with oil palm, and in some fragmented blocks, but only small number of large trees (*Anarcansiaceae*) remained. Degradation of Petalangan environment was primarily consequence of different logging and plantation industries' actions. But besides these also local people posed threat to the environment. From the early 2000s, around the edges of the MM plantation, locals had been chopping down existing forest to cultivate their own oil palm or other crops, also enclave areas might have been growing due to local's actions.

The Petalangan livelihood based before on the subsistence type of agriculture (Chou 2006). They practised shifting cultivation, fishing, hunting, collected forest products and cultivated community rubber plantations. Forest and rivers were major sources of livelihood. Ground areas were utilised as agricultural lands, wet lands were sources of lumber and rattan; rivers functioned as source of fish and means for transportation in the absence of roads. Shifting cultivation was practised with paddy rice in rotation system with hard trees like durian (*Durio*) or jenkol (*Archidendron pauciflorum*). Usually rise paddy was harvested once in a year for subsistence. Collected forest products included rattan, resins, yellow sandalwood (*Santalum*), aloe wood (*Aquilaria* sp.), jetulung (*Dyerra costulata*) and rubber-like trees. Aksenta (2007b) gave some examples of non-oil-palm sources of income. Contemporary prices for milled rubber were up to Rp 7000 per kg. Average daily production was about 10 kg. As rubber management required monthly 10-20 days of rubber slicing it could yield Rp 700 000 – 1 400 000 in a month. Before, fishing could yield up to 30 kg of fish in a week, but recently only 7 kg/week. When logging was possible it could yield for male inhabitants as much as Rp 200 000 per weak.

To some extent traditional way of life was still practised, but forest was not any more productive source of livelihood and paddy planting was diminishing (Aksenta 2007a). Population had been growing, but at the same time available land had been decreasing.

Food plants were cultivated less and more often bought from market. People needed to invest rubber and oil palm to fulfil their needs for the daily consumption. Economic status had risen. Local communities got their drinking water from excavated or deep artesian wells, but during the summer, water debit had declined, and draught was a potential threat. Energy in a form of firewood was mainly derived from the plantations near the villages, construction materials as wood and resins were found forested areas. Medicinal plants were rarely used since healthcare and medicines were available. There existed no hunting grounds in the HGU. It was common for local family to be at morning managing rubber plantation, and evening fishing. Usually men were fishing whereas women collected latex (Chou 2006). Often fishing required extended stays away from home and construction of temporary huts. Fish and rubber were sold to the collectors who came from different parts of the Riau Province or were sold to the market of Sorek.

Rivers were important ecosystem services providers for cooking, bathing and washing clothes (Aksenta 2007b). Majority of communities were living close to them. Often villagers utilised river water for drinking – even though its quality was poor. Almost 95 per cent of close communities were using rivers and artificial drainage canals in HGU area for fishing. According to local people diminishing fishing yields were due to river pollution by plantation, use of toxins to catch fish and cleaning the mud sediment in the plantation. The Aksenta team recognised that riverside vegetation was very important for fish to lay eggs. Rivers were important source of water for local inhabitants as well for oil palm facilities and plantation.

Plantation development had created extensive road networks (Aksenta 2007b). This served local people who had only river access or bad roads before the companies. Road networks have invigorated local movement and commerce especially in the Sorek area. Also, Tanjung Beringin gained better transportation access due to company's arrival. Though, public transportation was lacking excluding areas close to Sorek.

According to Aksenta the condition of health facilities in the Pelalawan Regency were relatively adequate. Musim Mas plantation had its own clinic and ambulance for emergency aid or lesser health problems for the employees and surrounding communities. According to regional development board (BAPPEDA 2006) district of

Pangkalan Kuras had 11 doctors of medicine (5 general and 6 specialised), one dentist, 11 midwives, and 14 nurses. These were treating population of 37 300 people. Most common diseases in the Pelalawan regency were respiratory infections, musculoskeletal diseases, diarrhoea and high blood pressure, also allergies, skin infections, malaria and scabies were common (BAPPEDA 2006). Health aspects were not further studied in Aksenta's (2007b) report, but it stated that air pollution might be a problem affecting to the health of employees and close communities. Also, water pollution is mentioned, and 2007 there seemed to occur severe leakages of waste disposal to the river from oil palm mill. Company's operation has generally decreased the quality of nutrition and health in its working area: availability of clean water has had disturbances and amount of fish yields has been decreasing. Especially during the dry season availability of water for daily consumption has been constrained.

In its HGU area Musim Mas provided facilities to primary education to the employee's children but accept also children from the villages. Secondary education was available in Sorek. There were 175 students in the primary school at Tanjung Beringin and 298 students in Betung in the year 2003. (Aksenta 2007b)

Also, Aksenta team (Aksenta 2007b) recognised that there was ongoing agrarian change. Local's livelihood in general had changed in many ways: from subsistence to money users and consumers. Agriculture had been developing towards more commercial practices due to adoption of rubber and oil palm crops. Oil palm cultivation or KKPA membership was regarded important by locals. However, independent oil palm cultivation seemed to be challenging to locals due to the lack of information and proper knowledge to cultivate, lack of seeds, and high investment required to found an oil palm plot. Effendy (1997) already noted that the Petalangan had been beginning to abandon their ancestral values and traditional way of life, even migrating. Dry field cultivation was diminishing, and some were seeking to "work as factory hands or to become (small) traders, while a small minority have become civil servants". Some groups chose to work with palm oil companies and abandoned their ancestral homes to "move to new settlements that have been provided by the companies". Also, according to Aksenta (2007b) value systems related to land had changed: traditionally selling of land was teemed impossible, its non-monetary value was important. Forest was still identified as

an important source of livelihood, but the old taboos, sacred issues and magical beliefs related to land had less meaning, and the communities readily sold land valuing more economic aspects. Batin's role as a religious and administrative leader had been diminishing or cancelled. The village chief had now the authority, and there might happen tensions between these two institutions. There were three major drivers identified by Aksenta (2007b), which affected social transformation: weakening of traditional institutions; economic development and valuing of land.

According to Aksenta team (2007b), the Petalangan had been left out from contemporary industrial developments and were experiencing loss of land and natural resources, though they were benefitting from KKPA-schemes and better access roads. Indigenous communities had tended to sell their lands to non-native residents to get money. Locals might had not been able to plan well their money use and short-sightedly were spending for consumptive goods. The Petalangan were also losing working opportunities. Plantations offered work for car drivers or plantation employees, but seldom was a Petalangan employed due to lower education, skills and different "working ethos" not accustomed to regular working hours. They might had been skilled in shifting cultivation but lacked principal capabilities to work as plantation worker. On the other hand, locals felt that being company employee would narrow their traditional income sources and salary was not considered to be enough to compensate loss of these other activities. Working in the plantation might have been considered too binding without enough freedom. Often rubber tapping, or fishing were considered more important than working regular work-hours with a company. Plantation workers were often immigrants from Java, North Sumatra and Nias, only few indigenous youths and women were working. Aksenta team (2007b) recognises that there had been conflicts and disturbances between PT Musim Mas and locals. These includes landownership issues between local community and company; employee and company relationship; important livelihood sources disturbed; and attitudes of local people to uneven changes. Companies as well locals had sometimes difficulties to adapt on each other. However, during the survey, they did not find any severe social fluctuation in the communities. Still, they predicted that in the future there might be increased risk to conflicts if local communities and their needs would not be sufficiently taken into consideration in the PT Musim Mas corporate policies.

4 OBJECTIVES

My research is a households' ecosystem services and well-being assessment in an oil palm dominated environment. I seek dependencies between oil palm smallholding, ecosystem services, livelihood and well-being.

Main objective and research question of this study is to try to understand what livelihood and well-being effects oil palm smallholding has to local households? How oil palm smallholders' well-being is produced in an oil palm dominated agroecological environment? What ecosystem services are present in the oil palm dominated environment? Which elements constitute smallholders' well-being? How present ecosystem services available might affect to smallholders' constitutive elements of well-being, and well-being in general? What is the current state of smallholder's well-being?

The hypothesis is that although the land use change to cultivate oil palm causes significant decrease in quality and availability of ecosystem services, better income level derived from the oil palm agroecosystem compensate the loss of ecosystem services and even causes higher level of livelihood and well-being than before oil palm smallholding.

I see my household data as an example from an oil palm dominated agroecosystem, as such it depicts households in an oil palm dominated environment whether households participate or not cultivating oil palm. I consider, that this oil palm dominated agroecological niche has effects to all households in it. However, as my goal is also to sort out whether oil palm smallholding itself has any effects to households' livelihood and well-being I study differences between oil palm smallholding households and households without oil palm smallholding.

5 MATERIALS AND METHODS

5.1 Methodological setting

The discipline of Agroecology studies "ecological systems modified by human beings to produce food, fibre and other agricultural products" (Conway, 1987). Human beings are an integral part of agroecosystems, which adds a socio-economic dimension to ecosystem analysis. Agroecosystem is "a complex agro-socio-economic-ecological system" and to understand a certain agroecosystem, one must gather information from higher and lower level according to systems theory (Conway & McCracken 1990). In this study I see the oil palm culture as an agroecological system. According to Khrishna (2014) some agroecosystems can be very large covering different regions and even continents such as Wet Land Rice agroecosystems of South-East Asia, Temperate Wheat Cropping Zones of European Central plains or Citrus plantations of Florida. I consider oil palm culture to form same kind of super agroecosystem. In this study I do not delimitate agroecosystem solely to field or plantation unit but saw it on landscape level due to oil palm cultivations dominance and area requirements in landscape. According to Gliessman (2015) on landscape level agroecology studies interactions between agroecosystems and natural, semi-natural or other rural or urban land use options. Usually agricultural landscape is a mixture of various kinds of ecological niches and patches accounting complicated ecological mosaic, conceptually boundaries of agroecosystems and natural ecosystems can be arbitrary. Agricultural landscapes are multifunctional where "natural ecosystem services blend with agroecosystem processes" (Gliessman 2015). As a result, interactions betwixt natural and agricultural ecosystems can be complex enough not to be easily distinguished from each other.

To understand how well-being is generated or affected in the oil palm dominated landscape (or agroecosystem), I utilize ecosystem services framework (Figure 4) as introduced in the Millennium Ecosystem Assessment (MA) (MA 2003). MA (2003) sees people as part of the environment, which can be managed sustainable ways for people's benefit: a utilitarian and normative point of view. MA (2003) assumes that "a dynamic interaction exists between people and ecosystems" and that "the changing human condition serving to both directly and indirectly drive change in ecosystems and with

changes in ecosystems causing changes in human well-being". According to MA (2003): "Ecosystems are essential for human well-being through their" ecosystem services i.e. "benefits people obtain from ecosystems" (MA 2003).

According to MA (2003) biodiversity is the fundamental source of ecosystem services: "Biodiversity is the source of many ecosystem goods, such as food and genetic resources, and changes in biodiversity can influence the supply of ecosystem services." Services are divided into four different functional categories that are at some degree flexible and overlapping: supporting services are the base for provisioning, regulating and cultural services.

Supporting services encompass such processes like the provisioning of habitat, the primary production, production of atmospheric oxygen, soil formation and retention, nutrient cycling, and water cycling. Their impacts on people are either indirect or occur over a very long time. Sometimes it is difficult to draw a line whether the service is supporting or regulating service.

Regulating services are the benefits obtained from the regulation of ecosystem processes. These includes for example air quality maintenance, climate regulation, water regulation, erosion control, water purification and waste treatment, regulation of human diseases, biological control, pollination, and storm protection.

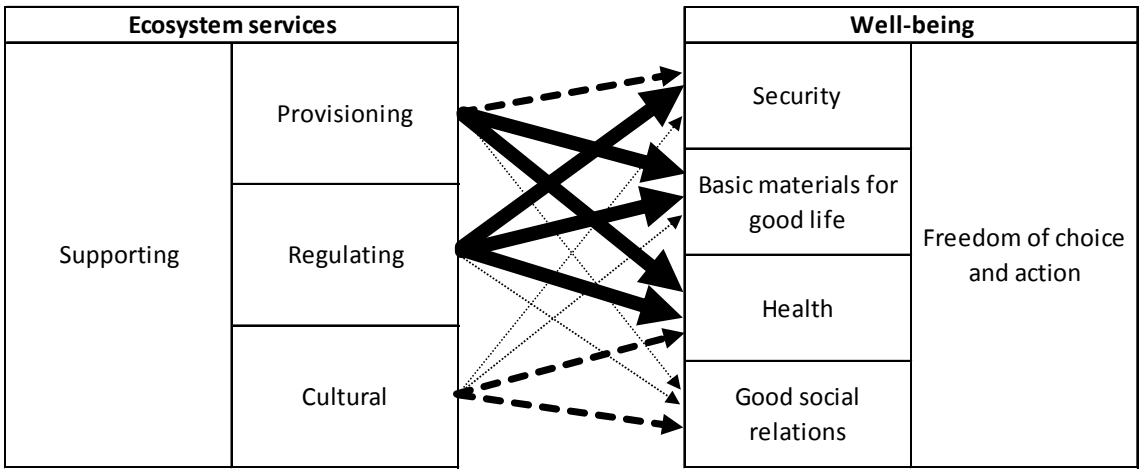

Figure 4. Ecosystem service framework according to MA (2003). Arrows depict intensity of linkages between ecosystem services and human well-being from weak to strong. My drawing based on MA (2003).

Provisioning services includes the products obtained from ecosystems. These are more easily identified as plain goods. These are for example food, fibres, fuel wood, timber, genetic resources, biochemical, natural medicines, ornamental resources and fresh water.

Cultural services are the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences. These encompasses cultural diversity, spiritual and religious values, knowledge systems (traditional and formal), educational values, inspiration, aesthetic values, social relations, sense of place, cultural landscapes, and recreation and ecotourism.

MA (2003) redress ecosystem services as "constitutive elements of well-being". Change in the quality and amount of ecosystem services reflects directly and indirectly in well-being and standard of living. Direct effects happen quite instantly via "locally identifiable biological or ecological pathways" (MA 2003). Indirect effects do not come visible until after a considerable time lapse, decades or more via "complex webs of causation, including social, economic or political interactions" (MA 2003). Effects can be beneficial or detrimental or something between. Despite its anthropocentric tendency MA (2003) recognises ecosystems importance "beyond their role for human well-being". The main problem is how to simultaneously sustain the ecosystem functions and utilise them to enhance human well-being and livelihoods. For this end, users of these services must have possibilities to manage their lives and livelihoods with equity, sustainability, capability and ecosystem stewardship. This can happen if people are free to participate; has economic facilities; are socially free; can have transparency guarantees; has protective security; and ecological security. With these freedoms, people can "create institutions to protect and oversee a fair and equitable distribution of these rights for all members of society" (MA 2003). However, ecosystem services do not transform to well-being without functioning institutions and stable decision-making structures. In this people needs incentives and values to favour sustainability over the instant profits from ecosystems.

The concept of livelihood, according to Chambers and Conway (1992) “comprises the capabilities, assets (including both material and social resources) and activities required for a means of living”. Kofinas and Chapin (2009) highlight concept of the ecosystem stewardship, where livelihood stems from ecosystem services: they see that livelihood sustains human life and doing so produces well-being. In MA (2003) framework livelihood does not exist as one clear category: it is taken as granted or it seems to be dispersed among the MA (2003) well-being components. But as MA (2003) framework describes different components of well-being, it also seems to touch different livelihood methods and how well-being is affected by them.

There is no single agreed definition for the concept of human well-being (Summers et al. 2012). It is a broad and contested term. According to Kofinas and Chapin (2009) well-being means simply “quality of life”. Summers et al. (2012) sees that, well-being is made of four primary components: basic human needs, economic needs, environmental needs, and subjective happiness. According to MA (2003) well-being can be understood in contrast to poverty: well-being and poverty (i.e. ill-being) are the two opposites of the same continuum.

In MA framework (2003) human well-being is a composite of five key components: the basic material needs for a good life; freedom and choice; health; good social relations; and personal security. The necessary material for a good life includes “secure and adequate livelihoods, income and assets, enough food at all times, shelter, furniture, clothing, and access to goods” (MA 2003). Concepts of freedom and choice includes “having control over what happens and being able to achieve what a person values doing or being” (MA 2003). Health includes such components as “being strong, feeling well, and having a healthy physical environment” (MA 2003). Good social relations include “social cohesion, mutual respect, good gender and family relations, and the ability to help others and provide for children” (MA 2003). Security includes “secure access to natural and other resources, safety of person and possessions, and living in a predictable and controllable environment with security from natural and human-made disasters” (MA 2003). Furthermore, “meaning of well-being’s different components or how these components are experienced or expressed by individuals vary since they are context-

and situation-dependent" (MA 2003). They reflect local social and personal factors such as: geography, ecology, age, gender, and culture.

Summers et al. (2012) criticise MA (2003) not to grasp sufficiently the whole of well-being concept "as advocated by well-being literature including physical, mental, and social well-being". Though, they acknowledge MA (2003) as a "useful framework" for exploring links between ecosystem and well-being. Since MA can explore ecosystem, its services and their effects to the human lives I follow the framework. As Summers et al. (2012) state, the value of MA (2003) resides in its "recognition of interdependability of well-being and natural environment".

Sustainable livelihood is the goal of Millennium Ecosystem Assessment (2003). It outlines concept of development as "sustainable enhancement of human well-being". MA defines sustainability through livelihood by three aspects: A livelihood is sustainable if it can maintain its functions over time; it does not diminish the livelihoods of others; and it does not deplete ecosystems at the expense of livelihoods over time. In the words of famous slogan: sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED 1987).

5.2 Materials

5.2.1 Sources

Primary source of data consists of 64 semi-structured household interviews (Picture 4) conducted in the two villages of Tanjung Beringin and Betung (in the central cluster), situated in the District of Pangkalan Kuras in Pelalawan Regency of Riau Province, Sumatra, Indonesia. I made 32 interviews in both villages. Besides household interviews there were some interviews with PT Musim Mas plantation personnel and group discussion in village meetings.

Picture 4. A household interview. Interpreter is writing down basic demographic data. From the travel album of Jani Kärkkäinen.

Picture 5. Studying household's features in the village office of Betung. From the travel album of Jani Kärkkäinen.

5.2.2 Secondary sources

Secondary material for triangulation and verification of my primary data was collected from various sources. I have acquired data from the Musim Mas' research department in a form of different studies and papers that they themselves have produced about

various issues. Three most important papers are the social impact assessment (Aksenta 2007b), the High Conservation Value-report (Aksenta, 2007a) and internal report about Kesuma Village (Musim Mas 2008). In addition, MM provided maps and information about agricultural practices on their plantation and the smallholder cooperatives. Information about demographics has been received from government offices of village (Picture 5), department and regency level.

5.3 Methods

I describe methodology used in this study as a mixed methodology. According to Holland and Campbell (2005) in the mixed methodology quantitative and qualitative data are utilised in the same research. With the mixed method approach a research question can be understood better than by quantitative or qualitative approach solely. Qualitative data and analysis can bring depth and substance in addition to quantitative data. On the other hand, quantitative data and analysis can enhance validity of qualitative data. Mixed methodology is pragmatic and discusses constantly between data and theory. Emerging data can even affect and change research questions during the research. In mixed approach it is possible to test and create theory at the same time, whereas in pure quantitative research hypothesis is often immutable. Main source of the data in my research consists of semi-structured household interviews. Questions are mainly quantitative in character, but also qualitative data is acquired with open-ended-questions and in the form of relevant side notes. The MM personnel interviews were unstructured, and their content is mainly qualitative.

I started to plan this research project during the fall 2007. In that point the research subject and tentative research questions were formulated by myself. I used Rapid Rural Appraisal (RRA) (Conway & McCracken 1990) as the methodological base. RRA is “a systematic, but semi-structured, activity carried out in the field by a multidisciplinary team and designed to acquire quickly new information on, and new hypothesis about, rural life” (Conway and McCracken 1990). RRA highlights the concepts of prudency and triangulation. Prudency imply to avoiding irrelevant aspects and triangulation to diversity of analysis. “Secondary data, direct observation in the field, semi-structured interviews”… …”all contribute to a progressively accurate analysis of the situation under

investigation" (Conway and McCracken 1990). Five key features of RRA are: Iterative, innovative, interactive, informal, and on the field. Goals of the study are not immutably fixed beforehand but modified during the research process. Interaction refers to interaction between different disciplines. Informal situations such as discussions or semi-structural interviews with different stakeholders are important source of information. Informality opens a wider door for information acquiring when formality do not function as a shade or sieve. Researcher is not a prisoner of his questionnaires but can also take a grip of other subjects rising from the discussion if considered important. Learning takes place largely on the field within interaction between researcher and his objects. Conway and McCracken (1990) argue that: "there does not exist standardised methodology, but techniques are developed according to situations and abilities of the researcher".

I have tried to follow RRA based thinking through my research project. My interviews were systematic and semi-structured. According to Conway and McCracken (1990) RRA was designed to be carried out by a multidisciplinary team, but in my case research on the field was carried out not by a multidisciplinary team but me as the sole researcher, assisted by couple of translators and help of Musim Mas Company. I have tried to compensate the lack of a team in collecting extensively secondary information and relying previous research. To manage collecting my data in reasonable time I was forced to design my methods as a one-man enterprise and leave out some interesting questions and methodological tools resulting shallower data. I was constantly aware of prudency and triangulation. I intended to collect as much as possible relevant secondary information, but with my primary data (household interviews) the ecosystem services framework guided me to concentrate to some key elements. All material collected aims to produce "progressively accurate analysis". My primary data collection was iterative: 64 semi-structured interviews in repetition and similar actions in both study villages. Iterativity as a methodological choice drove me to do many quantitative oriented interviews instead of fewer qualitative in-depth interviews. The RRA encourages to creativity, which I consider my partly novel questionnaire is a result of. My approach is also interactive in the RRA sense since the ecosystem services framework is an interdisciplinary construct per se. Interviews were carried out as informal manner as possible: only I, my interpreter and interviewees were present in the interviews which

happened usually in the interviewees houses. Also, questionnaires were not always followed slavishly, but other relevant interesting issues, as they emerged from interaction between the researcher and interviewee, were touched and written down. Interviews were made on the field as the household is the object of the inquiry. My original research questions have changed slightly from the beginning of the project. I consider that my methodology and research tools are result of incremental orientation to the local households' world in an oil palm dominated environment and as such has been "developed according to situations and abilities of the researcher". Questionnaire was largely developed on the field, not beforehand, though in the beginning I had some general questions formulated about ecosystem services. Without first-hand experience about context it would have been difficult to produce functioning questionnaire.

Actual research project was made in cooperation with the Viikki Tropical Resources Institute (VITRI), which is part of the Department of Forest Sciences in University of Helsinki. Through VITRI I was connected to the Bogor Agricultural University (IPB) in Java, which connected me with the University of Riau in Sumatra. These universities had again connections with the Musim Mas holdings (MM) that had plantations in different parts of Indonesia. Through this network of connections there opened possibility to do my research near a MM's plantation between 7th of June – 31st of august in 2008. In addition, IPB helped me to get my research permit from the government, without that it would have been illegal to do field survey. University of Riau provided me interpreter who was in my disposal during the field collection period. As a researcher I could influence site selection only after arrival to the MM plantation.

In addition to tentative literature research made back in Finland, I collected more information about oil palm industry and smallholders in the Bogor Agricultural University. During my stay in Bogor (2 weeks) I was also acquainted with the Center for International Forestry Research (CIFOR), which library proved to be very significant for my research: from there I acquired a CIFOR document (Sheil et al. 2002) in which my questionnaire is based on. In PT Musim Mas plantation I first familiarised with the plantation, the mill, the MM research department and other facilities in the area. I made few unstructured interviews with MM personnel to get to know the oil palm agriculture/industry and local situation with the smallholders. MM provided me

resources to carry out my research: an office to work in and logistics to reach different destinations. Later, in different phases of my field work MM introduced me to several government offices in different governmental levels (from whom I received variety of reports and statistical data), which might not be that easy for individual researcher without a corporate bond. MM also introduced me to the local villages.

Following RRA, my original research plan and the new data gathered I designed my methodology, research setup and sampling more carefully. I produced my questionnaire form based on Sheil et al. (2002), which was later translated to Indonesian language by my translator. Before the actual interview period I made two tentative interviews to find out how well the questionnaire functioned and how I needed to modify it. As a result, I abbreviated the form considerably and discarded some questions which were too difficult to explain or understand. Also, valuation scheme was modified. Consequently, interview length was maintained in about two hours. Collection was made mainly weekdays and took little less 2 months.
My goal was to select randomly two villages to where conduct my research, and secondly proceed on sampling households for interviewing in these villages.

Main criteria for villages chosen were:

- there must be a MM's KKPA present in the village
- there must be individual smallholders
- oil palm stands should be of even age
- villages should be about the same size
- It was also decided that one village must be from so called enclave area, which is surrounded by MM plantation and another outside of the MM area.

MM had 8 villages with KKPA. Outside Pt Musim Mas HGU area were Batang Kulim, Betung, Kesuma, Pangkalan Lesung, Pesaguan, and Sorek. In the HGU area were Talau and Tanjung Beringin. To satisfy all requirements I chose four villages of Talau, Tanjung Beringin, Kesuma and Betung for randomising. Then the two villages of Tanjung Beringin and Betung were randomly chosen. I met with village chiefs, KKPA leaders and RTM officials (Rumah Tangga Miskin, was a governmental program to identify and help the

poorest households) to get general picture of these villages, ecosystem services present and smallholders' livelihoods. From these meetings I gained copies of village monographies, household maps, land use maps and gained general statistical and other information relevant to my research questions.

To make statistical analysis possible and plausible I wanted to have three even sized sample populations for interviewing. In my research plan I had decided to do 30 interviews per village with three different sample groups. These had to be identified beforehand to make randomization possible. For this end I needed lists of households and village household maps where individual households were marked. Also, status (i.e. into witch sample group household belonged) of those households was needed to be recognized. In Betung this kind of map was available but lacking in Tanjung Beringin. Later a village officer in Tanjung Beringin draw a novel household map. During these initial interviews and data collection stakeholder groups were identified as KKPA smallholders (supported oil palm scheme), RTM (poor households) and independent oil palm smallholders. Then I randomly chose households to identified sample groups. Effort was also made to find female and male respondents for each group. Unfortunately, during the actual phase of interviewing I was forced to modify and even discard composition of my beforehand sampled groups. It became clear that it was not possible to get even sized sample groups and that sample groups itself were internally incoherent due to difficulties to categorise households. For example, sometimes KKPA member or individual smallholder were also labelled as RTM (poor households), and some KKPA members had independent oil palm plots too. Sizes of these actual stakeholder groups varied significantly, solely independent smallholders were minority in comparison to KKPA growers. Due to time constraint it was not possible always try to follow preselected list of households. Sometimes people were not home or did not want to participate, and less randomised sampling on the fly was made if any pre-sampled households were not near.

My original study plan was to concentrate to ecosystem services produced by the field level oil palm agroecosystem, and to study their effect to smallholders' well-being. However, it became clear that the actual oil palm culture is a monoculture, and remaining ecosystem services besides oil palm bunches quite scarce. For this reason, I

needed to widen my perspective to the landscape level to get any meaningful results. My research includes a localised survey of ecosystem services present in different ecosystems in oil palm plots, rubber plots, home garden or vicinity of household, and in remaining forests (i.e. degraded patchy thickets of woody plants).

5.3.1 Questionnaire

I planned my questionnaire (Appendix 6) based on the CIFOR's document of "Exploring biological diversity environment and local people's perspectives in forest landscapes" (Sheil et al. 2002). Methodology introduced by Sheil et al. (2002) was designed to gather "natural resource information that reflects the needs of local communities". It was designed as "a multidisciplinary survey developed with indigenous communities in the forest-rich landscapes of the Malinau watershed in East Kalimantan (Indonesian Borneo)". Their questionnaire was designed to be used in in-depth interviews with some key stakeholders and was quite extensive and too time consuming for to be utilized with the approximately two hours long household interviews.

I modified the Sheil et al. (2002) questionnaire to respond my needs to identify and assess different ecosystem services (Fig 5.) present for the households in the oil palm dominated countryside, and relate them to the five components of well-being (the basic material needs for a good life; freedom and choice; health; good social relations; and personal security) as laid out in MA (2003). In my design the questionnaire form is divided to seven main sections:

- household demographics
- sources of income
- ecosystem services in agroecosystem level
- ecosystem services in landscape level
- dangers/threats of human activities to environment
- dangers/threats to local community
- aspirations of local community about their life and surroundings in present and in the future

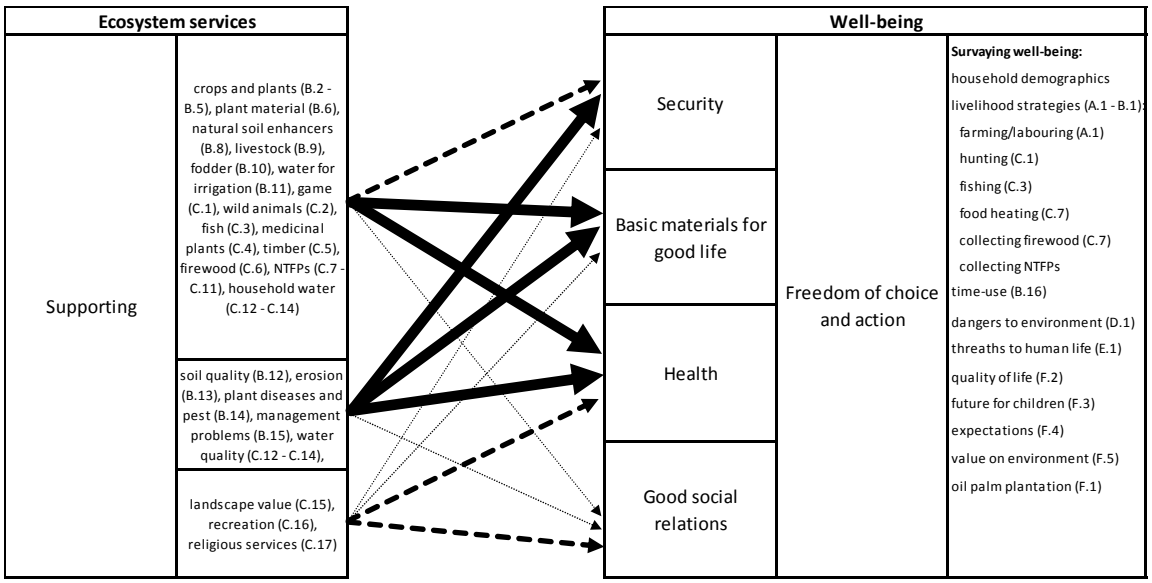

Figure 5. Ecosystem service framework according to MA (2003) added with questions from my questionnaire. Figure shows relevance and relation of my questions (A.1 – F.5) to ecosystem service framework.

First four sections include mainly quantitative data, whereas three last ones include open ended questions and some qualitative aspects. During the interviews emerged some additional, often qualitative information beyond the questionnaire that was also written down for later analysis. Strategy was avoiding asking questions directly about well-being, but approach indirectly to get more valid data.

Key points to obtain from household demographics was to identify into which stakeholder group household belonged with some additional features:

- local vs. immigrant
- independent palm oil smallholder, KKPA smallholder, rubber smallholder, landless people, fisher or labourer of some other trait
- very poor, poor, self-supporting? (Classification by local government)
- family size, marital status, religion, education level, age of household, profession and gender of household head can be used as variables in later analysis

To survey household's livelihoods, I asked about income sources, expenses, and what valuable goods household had. In the "sources of income"-section main livelihood strategies for household's income generation were identified. Quantity of income per

month was asked. Income was attached to its source. If income was generated from plots owned by household, then income was attached to these plots. Also, household expenses were asked: how much money was spent on food? With the "valuable goods owned-list" it was intended to find out the state of households' valuable belongings and when acquired, and if acquiring had correlation with livelihood strategy i.e. starting to cultivate oil palm or when people started to accumulate income from some other source. I also inquired all plots and land owned by the household: size and in what use these were, and how long had been owned. Time usage in key activities of household was also assessed: how much time was used for different livelihood strategies weekly or how often some activities were done (farming, labouring, fishing, hunting on collecting some NTFPs like firewood)?

The goal of the ecosystem services in agroecosystem level–section was to construct picture about how household's agroecosystem systemically functioned and what ecosystem services were present in it. In addition, I asked about household's agricultural management practices and problems:

- Were any agrochemicals, fertilizers or natural soil improvers were used?
- Where the plant material for cultivation was obtained?
- What was quality of soils in plots?
- What was degree of erosion?
- How was situation with plant diseases and pests?
- What management problems household had?

In the "ecosystem services in general"-section the goal was to find out what ecosystem services (and in what quantity and quality) there were outside of the household's imminent agroecosystem. However, division between agroecosystem level and surrounding ecosystem level proved to be somewhat fluid and artificial as some services were present in both spheres. I chose some important variables to ask from well-being's point of view:

- Was somebody in household hunting or fishing?

- What fuel was used for heating food (firewood, charcoal, gas, kerosene, etc.) and quantity used per week?
- What was situation of household water (quality, availability, exhausted water sources)?
- What was quality of current landscape?
- What recreational places available for the household?

From agroecosystem and ecosystem surveys I produced lists about plants and animals in these spheres. It was emphasized whether plants were cultivated in / collected from homegarden (or vicinity of house), rubber or oil palm plot, or from forest, or bought from market.

- What crops was cultivated and where?
- What NTFPs were collected and from where?
- Was there some NTFPs that could not be possible to get anymore and if they could be obtained from market?
- Why certain plants were used: for food, medicinal, religious or handicraft means?
- Which kind and what quantity of livestock the household had?
- From where fodder for the livestock was obtained?
- What animals was seen in the village?
- What fish species were catch from the rivers?
- From where timber was obtained?
- From where firewood was obtained?

I build in the questionnaire a non-monetary valuation scheme about quality and availability of some ecosystem services. First the valuation scheme had five grades from “excellent” to “bad” (1-5). Middle grade (3) was “undecided” or “not good or bad” but based on my tentative interviews I decided to discard it because it became the dominant grade, and I consider that its informative value was quite low. I wanted to force my interviewees to take a stand, whether the situation dealing with certain ecosystem service under question was good or bad. Final grading included four grades: “very good” (1), “good” (2), “bad” (3), “very bad” (4). Following questions were asked for evaluation:

- What is quality (fertility) of your soils?
- What is the situation (quality) of plant diseases or pests?
- What is availability of wild game?
- What is availability of fish for fishing?
- What is availability of natural medicines?
- What is availability of timber?
- What is availability of firewood?
- What is quality and availability of household water?
- What do you like (quality) current landscape?
- What do you think (quality) about oil palm plantation in the village area/vicinity of village?

Last seven questions were open ended and asked to survey smallholders' well-being and to find out what affects to it:

- What do you think about oil palm plantation in the village or in the vicinity?
- What threats people cause for environment?
- What threats there are for people?
- Is your life better than five/ten years ago? Why?
- What do you hope for your children/young generation?
- What do you expect/predict will happen in your village in the next few month/years?
- What do you think if the forest degrades or disappears?

Furthermore, important source of primarily qualitative data was formed from side notes. This bulk of information is used to validate and further connect ecosystem services to smallholders' well-being

5.3.2 Analysis

For analysing my interviews, I created a relational database with Access in which I input all raw data from interview forms. From database I produced variables, which I processed statistically is SPSS (Version 25) to find variances and dependencies for statistical hypothesis testing. I drew connections between ecosystem services, households' livelihood and well-being.

To answer my research question – whether oil palm smallholding had any livelihood or well-being effects to contestants – I proved connection between the oil palm smallholding and income level. Analysis of variance was used for testing dependencies of household income (numeric variable) on whether household practiced oil palm smallholding or not (categorical variable), which were treated as fixed variables in the ANOVA.

After this I proceeded to do various cross-tabulations with which I used the Pearson's Khii-squared analysis of significance to determine significance of dependency. I formulated three main categorical variables – households' oil palm smallholding status variable and two economic status variables – that I tested contra other variables. Households' oil palm smallholding status included two values, which were the oil palm smallholding household and non-oil-palm-smallholding household. The economic quarter variable included three values, namely the rich (upper quarter of households), the poor (lower quarter of households) and the middle-class (half of the households between the rich and the poor households) according to their monthly income. Alternatively, I used the economic halves variable in which I divided households only in two even sized halves according to their monthly income. I presumed, that responses with the quarter variable might have been more pointed than that of the halves variable.

In this study five levels of dependencies by significance has been considered: insignificant ($p > 0,1$), suggestive ($p \leq 0,1$), significant ($p \leq 0,05$), very significant ($p \leq 0,01$) and highly significant ($p \leq 0,001$). In some cases, I have used "≈" to signify as "nearly" or "close to" suggestive or significant.

6 RESULTS

6.1 Household demographics

Half of the interviewed households were from Tanjung Beringin and another half from Betung. All but one household were Muslim. Married households account 81 %, widowed 14 % and divorced 5 %. Altogether 251 inhabitants were living in households, 81 % were locals from different Petalangan clans and the rest were immigrants (Figure 5). Immigrants and their number: Aceh (1), Batak (12), Betawi (1), Javanese (29), Pematan (1) and Sunda (3). Petalangan clans and their number: Lubuk (21), Melayu (106), Mangkoto (1), Minang (1), Pelabi (40), Penyabungan (16), Petalangan (3), Piliane (3), Piliang (12) and Pinang (1). Households' size varied between 1 and 9 members, in average 3,9 members per household. Household's head was male in 84 % of cases. Household heads age ranged between 22 – 85 years, in average 43 years. 36 % of household heads had no education, 42 % had primary school diploma (SD), 16 % middle school diploma (SMP) and 6 % of high school diploma (SMA).

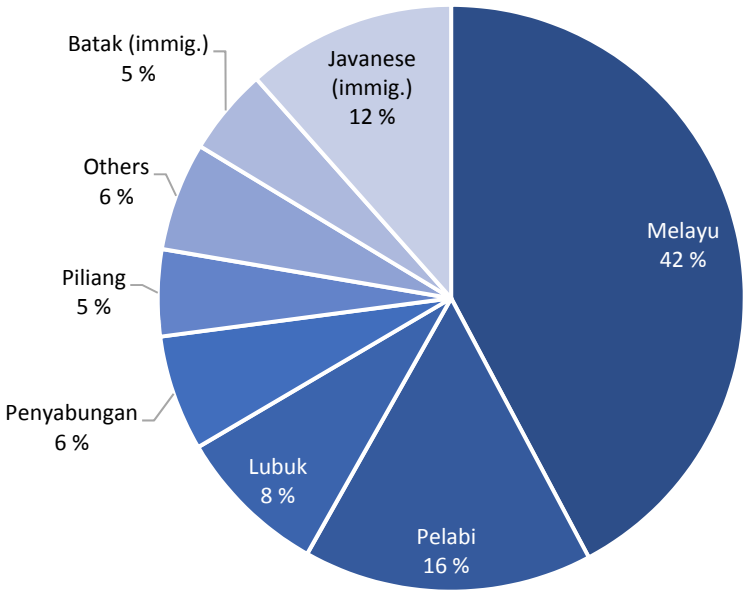

Figure 5. Households' inhabitants' ethnic division (%).

6.2 Livelihood

I identified five different agro- and ecological niches in the oil palm dominated landscape: oil palm plots (i.e. stands), rubber plots, homegardens, forest and rivers (Figure 6). From these niches oil palm and rubber plots were the major sources of income (together 87 % of monthly income) for the households. The "Other" includes income from different types of labour related activities and store keeping which are not related to mentioned niches.

Households' livelihood methods included farming, labouring, fishing and store keeping (Figure 7). Farming is defined here as an agricultural activity, which is carried out household's own land, namely in oil palm plot, rubber plot or homegarden. Labouring includes farming activities on others' land (in KKPA-, independent oil palm or rubber plots, or in oil palm or Acacia plantations as plantation worker) from which payment was received. In addition, labouring includes such activities (Figure 8) than logging, construction work, guardian, driver, teacher, blacksmith, village officer or religious worker (e.g. Imam). Fishing includes income from selling fish or further processed product such as smoked fish. Store keeping includes monthly revenue.

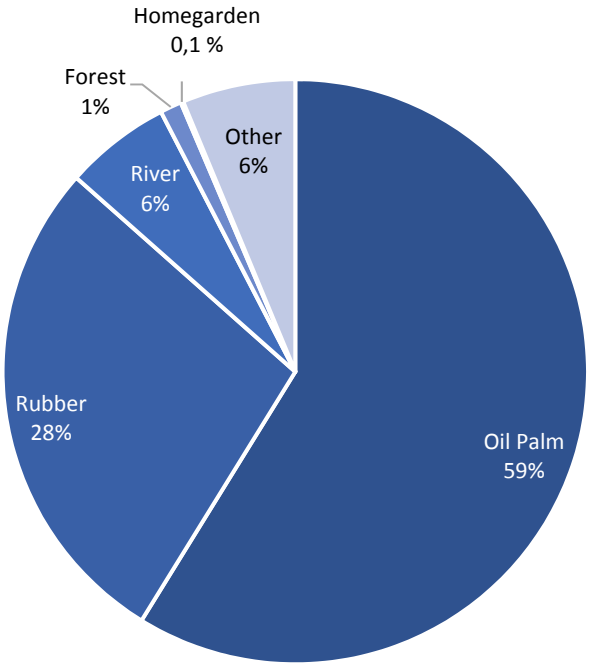

Figure 6. Share (%) of households' total monthly income generation according to ecological niches.

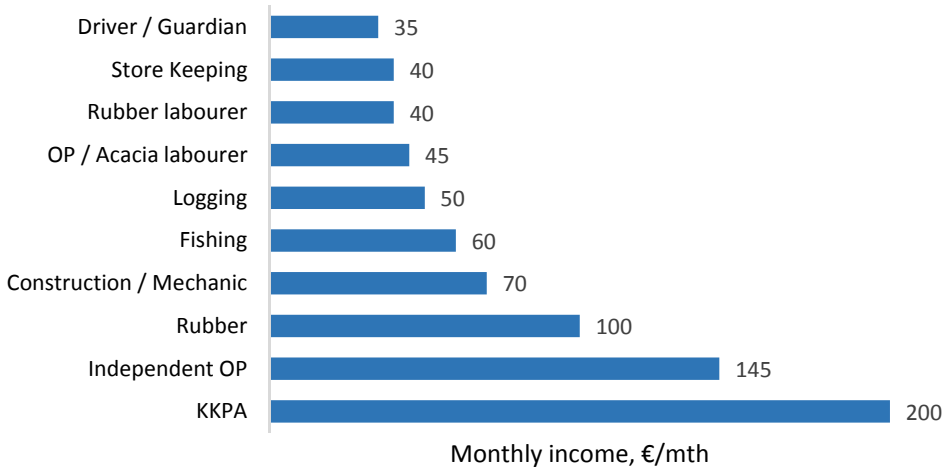

Figure 7. Households' monthly income according to income source rounded to closest 5 euros. OP = oil palm, KKPA = supported oil palm scheme.

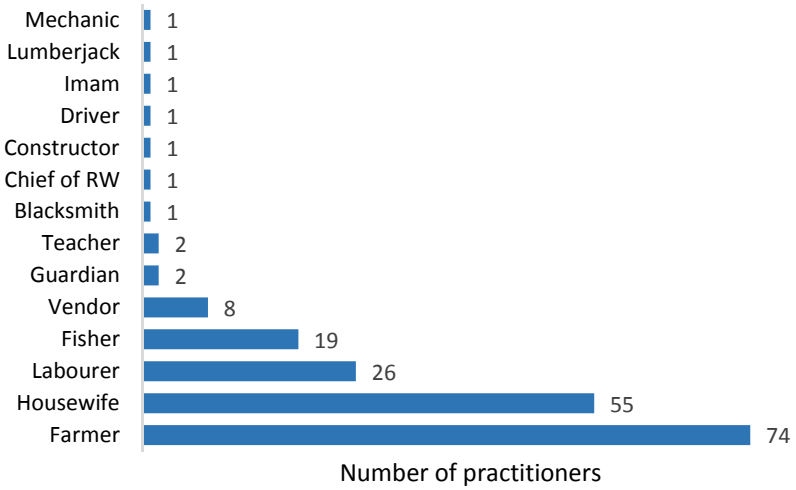

Figure 8. Household members' professions in numbers. One member might have one or more professions, a profession was mentioned 193 times.

Usually households combined different livelihood methods. There were altogether 38 oil palm households from which 24 % were independent and 76 % were KKPA members. From KKPA households fifth had also independent plots. From all oil palm households 74 % had rubber plots and roughly in the fourth of them someone was also labouring. All immigrant households excluding one (with a rubber plot) were landless, their main source of income was labouring. From households with local origin five were landless but laboured. Twelve households had only rubber plots, and half of them were labouring.

The monthly gross income, Rp 196 427 000 i.e. 13 600 € is a sum of all income sources of all household members calculated together (Figure 9): 66 % of households got income from rubber, 59 % of oil palm, half of them were labouring and fifth of them were getting income from fishing. According to ECB (2018) one euro was Rp 14 442,29 on second of June at 2008.

Figure 9. Households' combined total monthly income by income generating activities in Indonesian rupiah. OP = Oil Palm, Rb = Rubber, KKPA = supported oil palm scheme.

HH with oil palm	Mean	N	Std. Error of Mean
No	1513846,15	26	286052,215
Yes	4133342,11	38	470855,494
Total	3069171,88	64	341721,941

Dependent Variable: Monthly gross income

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	105928405172128,120[a]	1	105928405172128,120	17,998	,000
Intercept	492313225172128,060	1	492313225172128,060	83,648	,000
HH with oil palm	105928405172128,100	1	105928405172128,100	17,998	,000
Error	364903899937247,000	62	5885546773181,403		
Total	1073700529000000,000	64			
Corrected Total	470832305109375,100	63			

a. R Squared = ,225 (Adjusted R Squared = ,212)

Figure 10. Analysis of variance was used for testing dependencies of household income in relation to whether a household practiced oil palm smallholding or not. Sum of revenues are in Indonesian rupiah.

Households' income was highly significantly ($p \leq 0{,}001$) dependent with the oil palm smallholding status. The dependence of better income on owning at least one oil palm plot was highly significant ($p \leq 0{,}001$). Analysis of variance was used for testing dependencies of household income on whether a household practiced oil palm smallholding or not, which were treated as fixed variables in the ANOVA (Figure 10).

The total income of palm oil smallholding households was 173 % higher than the income of non-oil-palm cultivating households. The economic quarter variable and oil palm smallholding status had highly significant ($p \leq 0{,}001$) dependency between them. In the upper quarter of income 88% of the households owned an oil palm plot, in the middle class 72%, and in the lowest quarter 6% (one household only).

More than half of households' total monthly income was earned by the upper quarter of households, whereas the lower quarter earned only 6 %. Average monthly income for the upper quarter was 475 €/mth/household, and for the lower quarter 55 €/mth/household. Features of the upper and lower quarters differ in relation to their origin history, landownership rights, and livelihood methods or possibilities (Table 2). There was highly significant ($p \leq 0{,}001$) dependency between the economic quarter variable and KKPA membership, migrant status, landownership status, rubber farming status and labouring status.

Table 2. Features of the wealthiest and poorest 25 % of households.

Household feature	Poorest	Wealthiest
Migrant	44 %	0 %
Landless	56 %	0 %
Oil palm smallholder	6 %	87 %
KKPA member	0 %	75 %
Independent oil palm smallholder	6 %	56 %
Rubber smallholder	43 %	94 %
Labourer	69 %	25 %
Fisher	13 %	25 %
Store keeper	6 %	25 %

Indigenous status of households had highly significant ($p \leq 0{,}001$) dependency with the economic halves and economic quarter variable: all households of upper half and upper quarter were indigenous without exception. Also, with the oil palm smallholding status variable the dependency with ethnic grouping was highly ($p \leq 0{,}001$) significant: 97 % oil palm smallholders were indigenous.

I gathered from the 29 households some data about their historic livelihood changes. Before they started to cultivate oil palm they got their livelihood mainly from fishing, NTFPs or logging. Those who had some background as worker, driver or peddler changed to palm oil labourers. Also, some fisher and NTFP collectors preferred oil palm labourers work over their prior livelihood sources. One household commented that there were now more livelihood options than before. At least seven households had had KKPA plot, but had sold it afterwards, usually before producing age. Reasons for selling were: owner being sick, plot too far away or on too steep slope and difficult to manage, owner needed quickly money, or wanted to bough a motorbike. One household sold the KKPA plot (because too far away), bought a moto and founded independent oil palm plot closer to the home with the selling price. Selling prices ranged from Rp 2 000 000 (140 e) up to Rp 40 000 000 (2770 e).

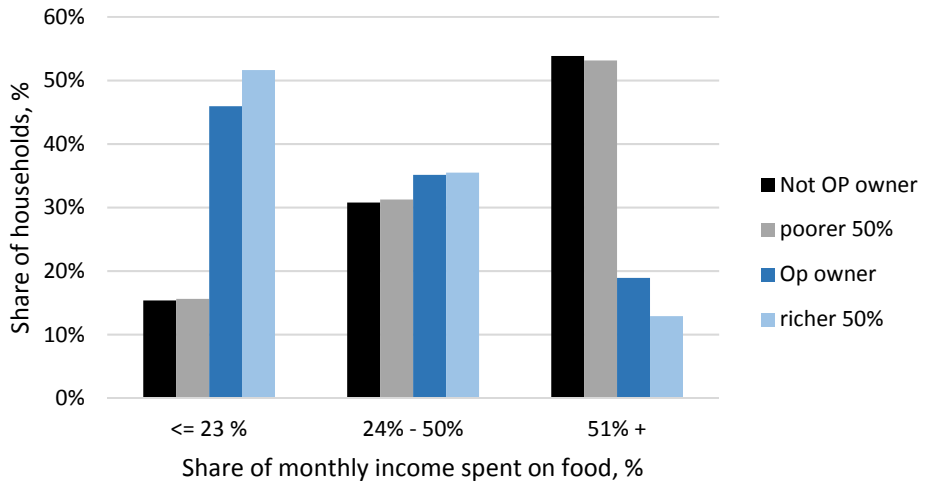

Figure 11. Households' food spending (share of monthly income spent in food. %) in relation to oil palm smallholding and in relation to wealth. OP = Oil palm. Households' spending was divided in three groups: less than 23 %, 24 % – 50 %, and more than 51 % of revenues spent on food. Then these groups were cross-tabulated with the households' oil palm smallholding status variable and economic halves variable.

In average the third of household's income went on food, 70 % of the poorest quarter's income went on to food, whereas 29 % of the rich. In absolute figures the richer quarter spend three times more on food than the poorer quarter. There occurred highly significant ($p \leq 0{,}001$) dependency between the economic halves status and percentage of income spent on food by households as well as very significant ($p \leq 0{,}01$) dependency on oil palm smallholding status (Figure 11).

More than half (59 %) of households had monthly payments for consumer credits: 18 % of their total income went to consumer credit payments. There occurred very significant ($p \leq 0{,}01$) dependency between the economic quarter variable and the percentage of income spent on consumer credits by households as well as significant ($p \leq 0{,}05$) dependency with the oil palm smallholding status (Figure 12): 44 % of the lower quarter's and 13 % of upper quarter's income went to loan payments mainly for motorbikes, television sets (including parabola antennas and other television related gadgets) or generators. There were four households which were spending more than 60 % of their monthly income to the consumer credit payments. At least the fifth of the oil palm smallholding households (including independent and KKPA producers) informed being paying labourers for taking care of their oil palm plots, expense being in average 15 % of households' monthly income.

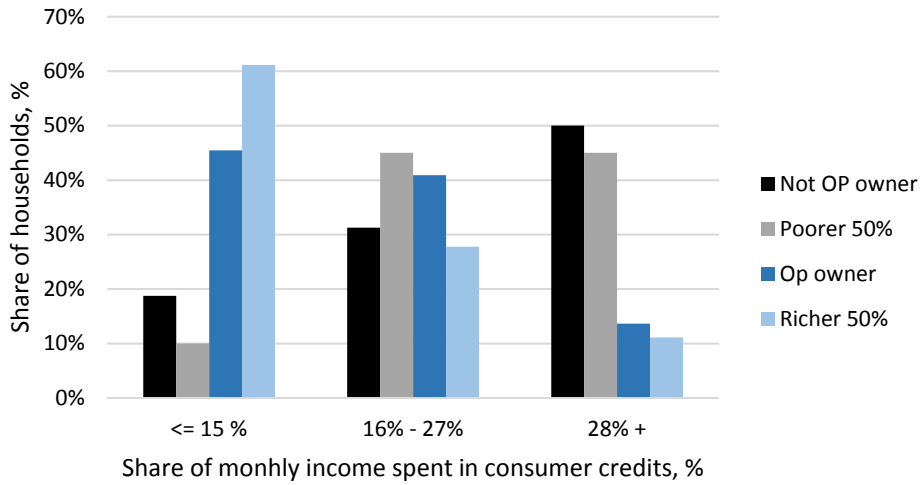

Figure 12. Households' consumer credits spending in relation to wealth and oil palm smallholding status. Households' consumer credits spending (share of monthly income spent in consumer credits, %) in relation to oil palm smallholding and in relation to wealth. OP = Oil palm. Households' spending was divided in three groups: less than 15 %, 16 % – 27 %, and more than 28 % of income spent in consumer credits. Then these groups were cross-tabulated with the households' oil palm smallholding status variable and economic halves variable.

Government had a “rice programme” in the villages, every household could get 12 kg of rice per month. However, rice was of bad quality, smelled foul as chemicals and some contestants did not eat it, but gave it to chickens as fodder or sold it forward.

6.3 Household valuables

Most common valuables owned by households were motorbike (77 % of households), electricity providing solution (generator or power line) (75 %), cellular (64 %), television set (53 %), and radio set (50 %) (Figure 13). When I combined television and radio sets, and hand phones to one class of the information technology: it was the most common class of valuables owned (86 %). In addition, households owned bicycles (5 pcs.), canoe engines (3 pcs.), cars (3 pcs.), chainsaws (6 pcs.), freezers (1 pc.), generators (14 pcs.), and water pumps (10 pcs.).

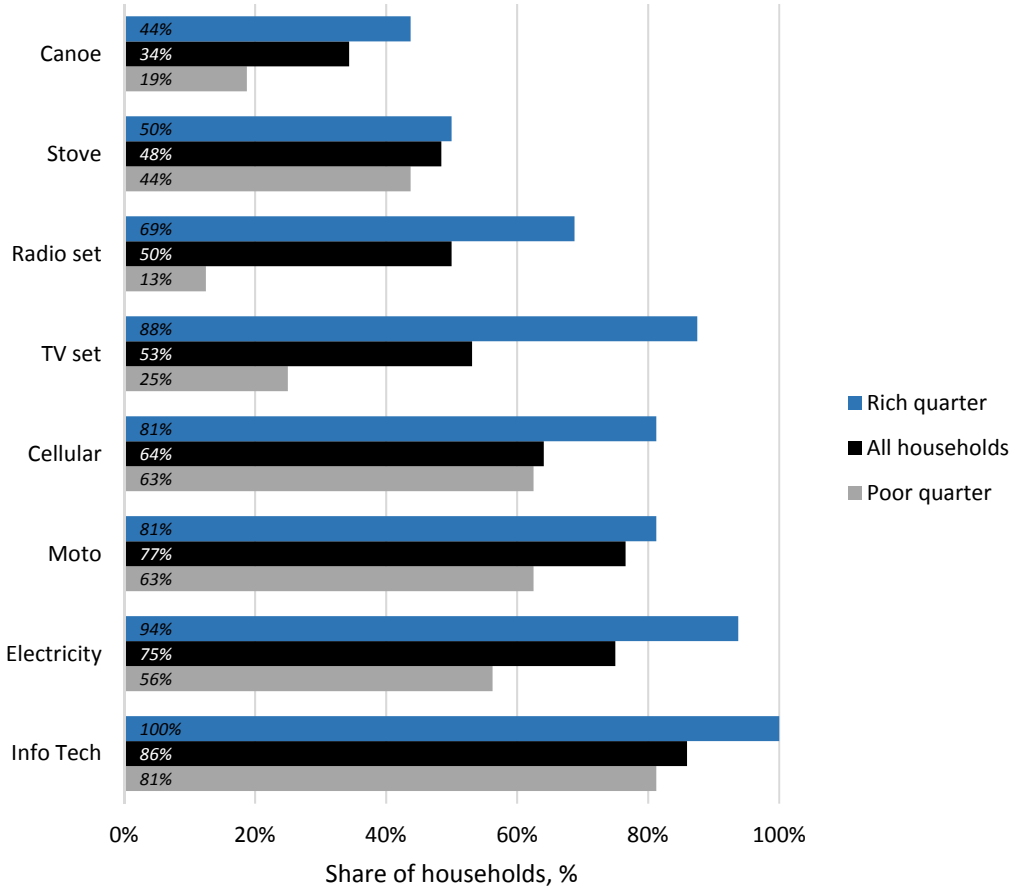

Figure 13. Share of households owning certain valuables by the poor quarter and rich quarter, and of all households. Electricity refers to electricity providing solution i.e. generator or power line from the grid.

There was suggestive ($p \leq 0,1$) dependency between the information technology and the wealth (the economic quarters variable) as well as with the oil palm smallholding status: 92 % of oil palm smallholding households had some information technology gadget whereas the non-oil-palm households 77 %, and at least one of these gadgets were present in all the wealthier quarter households and in 81 % among poorest quarter households. Still, fourteen per cent of all households remained without any of these technologies. Canoe owning was highly significantly ($p \leq 0,001$) depended on wealth (the economic halves variable), and close to suggestive ($p \approx 0,1$) with oil palm smallholding status: 72 % of all canoes were owned by wealthier half of the households. With moto or stove ownership there wasn't any statistically significant dependencies observed.

According to assessment of household valuables, there were made at least 240 acquisitions, from which 96 % were made in the last 5 years. Of these the richer quarter had made 40 % and the poor 13 %. Among the KKPA members, their acquisitions were increasing accordingly maturity of the KKPA plots and rising income (Figure 14). As interviews were made in mid-year, figures of the year 2008 are incomplete.

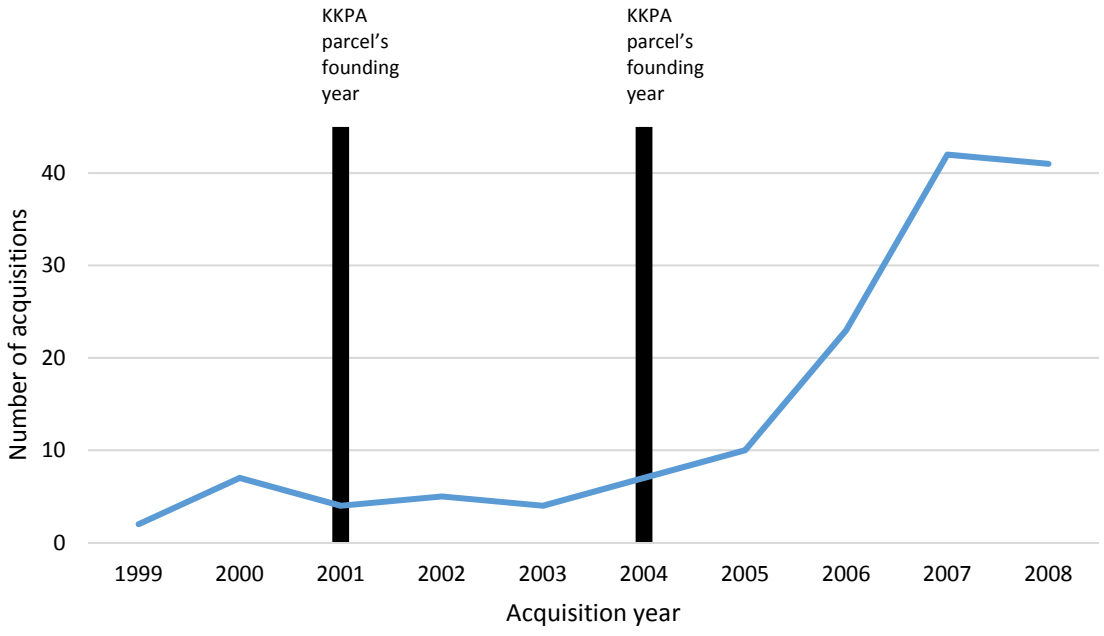

Figure 14. Quantity of KKPA member's acquisitions of household valuables made per year. The black bars indicate planting years of KKPA plots

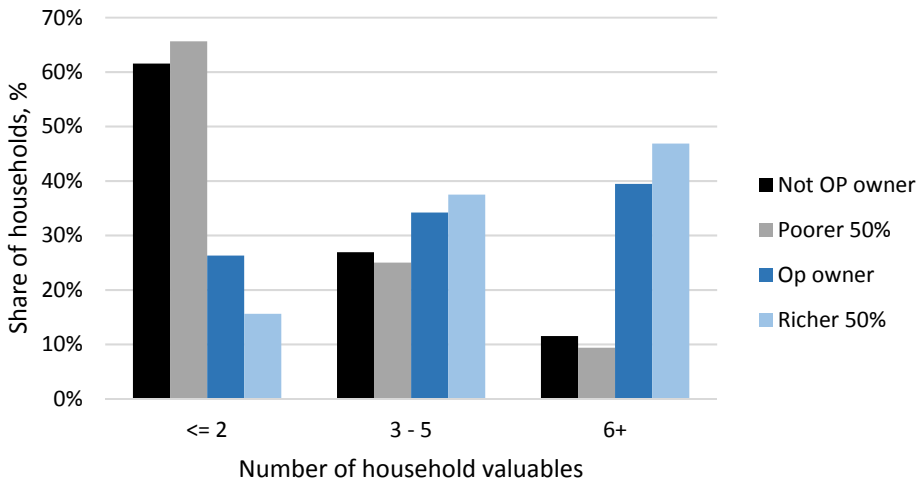

Figure 15. Households' number of valuables owned in relation to oil palm smallholding and in relation to wealth. OP = Oil palm. Households' valuables were divided in three groups: less than 2, 3 – 5, and more than 6 valuables. Then these groups were cross-tabulated with the households' oil palm smallholding status variable and economic halves variable.

There was highly significant ($p \leq 0{,}001$) dependency between wealth (the economic halves variable), and very significant ($p \leq 0{,}01$) dependency between households' oil palm smallholding status with the number of owned valuables (Figure 15).

6.4 Land ownership

Fifth of the households were landless, 59 % had oil palm plots and 66 % rubber plots (Table 3). Every household had a homegarden or at least homestead. One household had rice cultivation. From oil palm households 24 % were independent oil palm smallholders and 76 % KKPA members (from KKPA members 24 % had also independent or private plots). KKPA plots and rubber plots had almost the same average size per household of about 2 ha. However, average rubber plot size with the wealthy was 2,5 ha and with the poor little less than 1 ha. From eight households owning unused land area, five were from the wealthy quarter and only one was poor household. A land certificate from village office for 2 ha area cost Rp 40 000, but according to chief certification was rare, though certification was prerequisite for the KKPA membership.

Table 3. Land owned by households (ha). hh = household, OP = oil palm.

Land type	Number	Total area (ha)	Area/hh
Independent OP	16	44,2	2,8 (1,9*)
KKPA	29	68,0	2,3
Rubber	41	75,8	1,9
Unused	8	72,5	9,1 (3,2*)
Total	94	260,5	

***One case with a larger area is omitted from the mean in the parenthesis.**

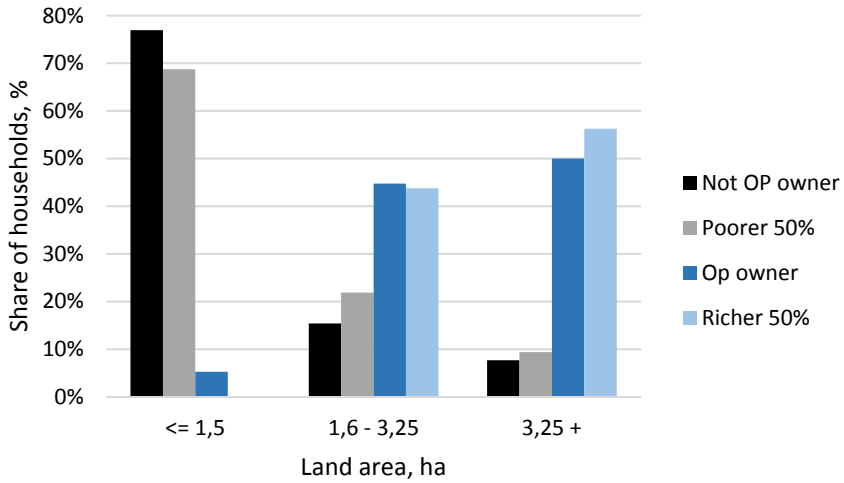

Figure 16. Households' owned land area in relation to wealth and oil palm smallholding status. Households' land area (Land area, ha) in relation to oil palm smallholding and in relation to wealth. OP = Oil palm. Households' land area was divided in three groups: less than 1,5 ha, 1,6 ha – 3,25 ha, and more than 3,25 ha. Then these groups were cross-tabulated with the households' oil palm smallholding status variable and economic halves variable.

Households' total land area was highly significantly ($p \leq 0{,}001$) dependent of households' oil palm smallholding status and income status (Figure 16). Households were divided in three even sized groups by land area: less than 1,5 ha, 1,5 ha – 3,25 ha, and more than 3,25 ha. Then these groups were cross tabulated with households' oil palm smallholding status and economic halves status.

6.5 Livestock

46 % of households had some livestock and 28 % had pets (Table 4). Poultry includes chicken (282), dove (32), roosters (3), ducks (2) and hens (2). Pets includes different kinds of pet birds (24), cats (13), monkeys (3), and dogs (2).

Table 4. Livestock owned by households.

Livestock type	Number of households	Number of animals
Poultry	29	321
Goat	2	12
Pets	18	42

Chicken were by far the most common livestock in households. It was stated by some contestants, that there used to be more poultry in households and some bigger producers too, but due to recent outburst of avian flu, stock was significantly reduced. Livestock ownership did not have any statistically significant dependency on wealth or oil palm smallholding. However, 63 % of the wealthier upper quadrant households, 47 % of middle quadrant and 31 % of the poorer lower quadrant had some livestock.

6.6 Electricity

Electricity was available in both villages, but in Tanjung Beringin it was produced by home generators, whereas Betung had its own small-scale power plant, 27 % of households got electricity from neighbour through power line with payment of Rp 10 000 – 50 000 monthly (0,7 – 3,5 e/month) mainly for light. In Betung cost of electricity was Rp 250 000 monthly (17 e/month) from PLTD (power plant). In Tanjung Beringin with home generators in average Rp 350 000 (24 e) was spend to diesel fuel (solar) monthly. There was very significant dependency ($p \leq 0,01$) between oil palm smallholding households and significant dependency ($p \leq 0,05$) between the economic quarter variable with the electricity using: 69 % of all electricity users were oil palm smallholding households, and 94 % of the higher quarter in comparison to 56 % of the lower quarter had access to electricity.

6.7 Flora

During interviews altogether 167 plant names or groups were mentioned on Indonesian language or on local dialect 743 times (Appendix 4). From these a specie or family of 73 % were identified. Remaining unidentified cases are mainly non-timber forest

products used as medicinal remedies. Commonness of a specie or family is defined according to how many household mentions it generally, and specifically in relation to ecological niches (homegarden, oil palm/rubber plot, forest). Twenty most common species or families form 12 % of species richness, but 60 % of all mentions (Table 5).

There occurred nearly significant ($p \approx 0,05$) dependence between wealth and number of plant varieties mentioned per household: 71 % of mentions in the class "14 varieties or more" were mentioned in wealthier half of households whereas vice versa in the class "less than 11 varieties" 61 % of mentions came from the poorer half. The economic quarter variable had significant ($p \leq 0,05$) dependency on number of varieties mentioned: 63 % of the higher quarter, 25 % of the middle class and 20 % from the lower quarter had mentions in the class "14 varieties or more" whereas tendency was reversed in the class "less than 11 varieties".

Table 5. Most common plant species or groups that households mentioned cultivating or collecting from homegarden, rubber or oil palm plot or from forest. No. indicates number of households mentioning the species.

English Name	Indonesian Name	Scientific Name	No.
rubber tree	karet	*Hevea brasiliensis*	44
oil palm	kelapa sawit	*Elaeis guineensis Jacq.*	42
banana	pisang	*Musa* sp.	40
coconut	kelapa	*Cocos nucifera*	36
rambutan	rambutan	*Nephelium lappaceum*	31
durian	durian	*Durio* spp.	26
ginger	jahe / lio	*Zingiber officinale*	25
mushrooms	jamur	*Fungi*	20
bamboo	bambu	*Bambusoideae*	19
chili	cabai/cabe	*Capsicum* sp.	19
cassava	kasava	*Manihot esculenta*	19
turmeric	kunyit	*Curcuma longa*	18
aromatic ginger	kencur / coku	*Kaempferia galanga*	17
rattan	umbut	*Calamoideae*	16
jambu	jambu	*Acmella oleracea*	14
dogfruit	jengkol	*Archidendron pauciflorum*	14
jackfruit	nangka	*Artocarpus heterophyllus*	14
papaya	pepaya	*Carica papaya*	14
cempedak	cempedak	*Artocarpus integer*	11
false mangosteen	asam kandis	*Garcinia xanthochymus*	10

6.7.1 Homegardens

Homegardens or homesteads had 64 different species or families (Table 6). From this roughly half were different kinds of fruit bearing plants. Vegetables or other arable crops were almost non-existent excluding cassava, chili, or turmeric. Often “homegarden” consisted of a yard with some older fruit trees surrounding a house and nothing else. More than half of homegarden species were mentioned cultivating only in two or single households.

There was significant ($p \leq 0,05$) dependence between the economic quarter variable and quantity of plant varieties in home garden: 56 % of the higher quarter had in their home garden 8 or more varieties whereas of the poorer quadrant 19 %. Result with the “4 or less varieties” class was ambiguous, but it was the most common situation to occur in almost 25 % of households.

Table 6. Most common plant species or families that households mentioned having in homegarden. No. indicates number of households mentioning the species in homegarden.

English Name	Indonesian Name	Scientific Name	No.
banana	pisang	*Musa* sp.	39
coconut	kelapa	*Cocos nucifera*	36
rambutan	rambutan	*Nephelium lappaceum*	31
durian	durian	*Durio* spp.	26
cassava	kasava	*Manihot esculenta*	18
chili	cabai/cabe	*Capsicum* sp.	16
papaya	pepaya	*Carica papaya*	15
oil palm	kelapa sawit	*Elaeis guineensis Jacq.*	15
jambu	jambu	*Acmella oleracea*	13
jackfruit	nangka	*Artocarpus heterophyllus*	13
cempedak	cempedak	*Artocarpus integer*	10
pineapple	nanas	*Ananas comosus*	9
ginger	jahe / lio	*Zingiber officinale*	9
turmeric	kunyit	*Curcuma longa*	8
dogfruit	jengkol	*Archidendron pauciflorum*	7
mango	manga	*Mangifera indica*	7
rubber tree	karet	*Hevea brasiliensis*	6
aromatic ginger	kencur / coku	*Kaempferia galanga*	6

6.7.2 Rubber and oil palm plots

Fungi were the most regularly utilised side products of the rubber and oil palm niches. Such varieties as big mushroom (jamur kukuran), rubber mushroom (jamur karet), oil palm mushroom (jamur sawit), white mushroom (jamur putih), and west mushroom (jamur barat) (in addition jamur paha ayama and jamur aku were available in forest) were mentioned. One third of the households reported eating mushrooms, but without statistically significant dependency on wealth or oil palm smallholding. In market of Sorek price for rubber mushrooms were Rp 25 000 per kilo. Besides mushrooms and corresponding crops, rubber plots were mentioned to have 20 (Table 7) and oil palm plots 6 (Table 8) different additional species.

Table 7. Plant species or families that households mentioned having in rubber plots. No. indicates number of households mentioning the species in a rubber plot. (The plants for which the species name is not known but in local language, are indicated by a question mark.)

English Name	Indonesian Name	Scientific Name	No.
rubber tree	karet	*Hevea brasiliensis*	42
mushrooms	jamur	*Fungi*	14
turmeric	kunyit	*Curcuma longa*	3
soursop	sirsak	*Annona muricata*	2
dogfruit	jengkol	*Archidendron pauciflorum*	2
jackfruit	nangka	*Artocarpus heterophyllus*	2
cempedak	cempedak	*Artocarpus integer*	2
chili	cabai/cabe	*Capsicum* sp.	2
eggplant	terung	*Solanum melongena*	2
ginger	jahe / lio	*Zingiber officinale*	2
jambu	jambu	*Acmella oleracea*	1
greater galangal	lengkuas	*Alpinia galanga*	1
pineapple	nanas	*Ananas comosus*	1
bamboo	bambu	*Bambusoideae*	1
false mangosteen	asam kandis	*Garcinia xanthochymus*	1
aromatic ginger	kencur / coku	*Kaempferia galanga*	1
banana	pisang	*Musa* sp.	1
bitter bean	petai	*Parkia speciosa*	1
ground cherry	ceplukan	*Physalis Angulata*	1
white rose	bunga omawar putih	*Rosa* sp.	1
tomato	tomat	*Solanum lycopersicum*	1
chinese long bean	kacang panjang	*Vigna unguiculata subsp. Sesquipedalis*	1
bush/root grass	rumput semak	?	1

Table 8. Plant species or families that households mentioned having in oil palm plots. No. indicates number of households mentioning the species in oil palm plots.

English Name	Indonesian Name	Scientific Name	No.
oil palm	kelapa sawit	*Elaeis guineensis Jacq.*	38
mushrooms	jamur	*Fungi*	6
bamboo	bambu	*Bambusoideae*	1
chili	cabai/cabe	*Capsicum* sp.	1
turmeric	kunyit	*Curcuma longa*	1
vegetable fern	paku pakis	*Diplazium esculentum*	1
galingale	galing puyuh	*Languas* sp.	1
yellow velvetleaf	genjer	*Limnocharis flava*	1

6.7.3 Forest

Households mentioned 108 different species (Table 9) from forests that were utilised for different purposes: 63 % were medicinal and 17 % for religious purposes. The specie or family was recognised for 64 % of cases. In 65 % of cases only single household mentioned using it.

Bamboo shoots were utilized as delicate food and stems as fabricating fishing rods and traps along rattan. Rattan was still used as e.g. a rope to bind things. Pandan leaves were utilised for weaving mats, baskets, containers or other handicrafts. Sap of a certain Maranx tree could be used as waterproofing walls and roofs when mixed with thinner. Before Lipai leaves were used to transport rice or food stuff, but now plastic pots were used instead.

There was suggestive significance ($p \leq 0,1$) between the NTFP utilization and the economic quarter variable as well as with the oil palm smallholding status. Altogether, non-timber-forest products were utilized in 74 % of households: 63 % of the richer quadrant, and 94 % of the poorer quadrant. From those who didn't use them, 77 % were oil palm smallholders.

Table 9. Most common plant species or families that households mentioned having from forest. No. indicates number of households mentioning the species in forest.

English Name	Indonesian Name	Scientific Name	No.
bamboo	bambu	*Bambusoideae*	15
rattan	umbut	*Calamoideae*	15
ginger	jahe / lio	*Zingiber officinale*	11
mushrooms	jamur	*Fungi*	9
aromatic ginger	kencur / coku	*Kaempferia galanga*	9
turmeric	kunyit	*Curcuma longa*	7
pandan / screw palm	pandan	*Pandanus* sp.	7
tuba root	kalimayo	*Derris elliptica*	6
long jack	pasak bumi	*Eurycoma longifolia*	6

Table 10. Most commonly mentioned medicinal plants and their medicinal effect. No. indicates number of households mentioning the species as medicinal plants.

English Name	Scientific Name	No.	Remedy
ginger	*Zingiber officinale*	25	anti-rheumatic, common cold, cough, eye, fever, headache, influenza, liver, muscle pain, mystical, tooth ache
turmeric	*Curcuma longa*	18	crying baby, muscle pain, stomach ache, wounds
aromatic ginger	*Kaempferia galanga*	17	anti-rheumatic, cough, ear, fever, headache, muscle pain, nightmares
false mangosteen	*Garcinia xanthochymus*	10	common cold
betel	*Piper betle*	9	headache, and everything
long jack	*Eurycoma longifolia*	7	back pain, malaria
curcuma	*Curcuma* sp.	7	anti-rheumatic, muscle pain, appetite
tuba root	*Derris elliptica*	6	common cold, fever, sprue

6.7.4 Medicinal plants

Altogether 75 plant species were mentioned having medicinal properties: 90 % were available from forest, 27 % from homegardens, 20 % from market, 13 % from rubber plot and 2 % from oil palm plots (Table 10). Use of medicinal plants was common practice in 88 % of households, no significant dependency on wealth or oil palm smallholding was observed.

Picture 6. Dukun's utensils and containers with some natural remedies. From the travel album of Jani Kärkkäinen.

Many stated that they went to seek first Dukun's help (Picture 6), and only after that to the health care centre if traditional remedy didn't help. Remaining 12 % explicitly stated that did not seek Dukun's help or preferred to use medicines of practicing doctor. One contestant even stated, that did not want to use traditional medicines anymore because "was now modern". In average three to four different varieties was mentioned by medicinal plant using households. There was close to suggestive ($p \approx 0,1$) dependence between indigenous people and medicinal plant utilisation: 78 % was used by indigenous people.

6.7.5 Religious plants

Forty per cent of households reported religious or magical uses for plants (Table 11), ten per cent did not believe in them, but prayed instead. These were often used as ingredients for apotropaic amulets, bracelets or tangkals against bad spirits or ghosts.

Table 11. Plants that had some religious or magical uses or meanings. (The plants for which the species name is not known but in local language, are indicated by a question mark.)

English Name	Indonesian Name	Scientific Name
greater galangal	lengkuas	*Alpinia galanga*
ylang-ylang	kenang	Canangium odoratum
curcuma	bolai	*Curcuma* sp.
jasmine	melati	*Jasminum* sp.
aromatic ginger	kencur / coku	*Kaempferia galanga*
pandan / screw palm	pandan	*Pandanus amaryllifolius*
monkey wood	jering	*Pithecellobium jiringa*
rose	mawar	*Rosa* sp.
wild snake gourd	kundu	*Trichosanthes cucumerina*
ginger	jahe / lio	*Zingiber officinale*
	benglai	?
	betalo	?
	cekair	?
	daun kopau	?
	gan tree	?
	kait gading	?
	kayu tatome	?
	kayu ibu-ibu	?

There was no significant dependency of religious plant use on oil palm smallholding, but some suggestive dependence ($p \leq 0,1$) on the economic halves variable: the richer half of households were using 69 % of all religious plants. There was close to suggestive ($p \approx 0,1$) dependence between indigenous people and religious plant utilisation: indigenous population was using religious plants in all but one case.

Households seemed to have some knowledge of natural remedies, but often local Dukuns i.e. traditional healers and spiritual counsellors (Stevens & Schmidgall-Tellings 2010) were prescribers and directors of their use. Usually patients were ordered to gather plants according to Dukun's instructions, to bring them to Dukun, which then prepared amulets, bracelets, tangkals or concoctions from them.

Tangkal (Picture 7) means generally a charm, talisman or amulet, it also means 'fending off' or 'repulsion' (Stevens & Schmidgall-Tellings 2010). Tangkals were often made from coconut leaves, or some other woody material with coloured cloth pieces, and with above mentioned special ingredients. Though, only 40 % of households reported magical uses, almost every house seemed to have one or more tangkals over windows and doors to prevent ghosts or bad spirits from entering in, or against other magical maladies or

possession, but also to protect from common diseases: especially protection for babies and dreams was mentioned. Tangkals could also protect crops, when placed in four corners of a field. Sometimes charms were made of pieces of paper with Quran verses (and installed black pouches), and placed in four corners of house, close to the ceiling for similar apotropaic purposes. Some tangkals were named: dame (prevent bad magic), sokoi, duri ukam (to protect baby from bad spirit), hantu kasar (against red haired spirit), hantu tubuh halus (against invisible paralyzing spirit), tunggab (causes ghost to fear). One contestant said that tangkals needed to be renewed every year and a dukun interviewed recommended them for everybody. One household possessed an Arabic language grimoire with pictures of various seals and diagrams for practicing magic.

Sialang trees (Picture in the front page) were mentioned in six households. Sialang trees were disappearing, but there were still some in MM plantation area, four in Betung village and some close to Napo River. One contestant stated that he learned secret mantras and magical rituals related to Sialang trees from a certain person who were still collecting honey from the trees. Learning process took two days and included staying close to the trees.

Picture 7. Different kind of tangkals over the door frame. From the travel album of Jani Kärkkäinen.

Table 12. Most common animal species mentioned. No. indicates number of households mentioning the species.

English name	Indonesian name	Scientific name	No.
forest pig	babi	*Sus scrofa*	59
leaf monkey	kokah	*Semnopithecus siamensis*	28
iguana / big lizard	biawak	*Varanus salvator*	26
pigtailed monkey	beruk	*Macacus nemestrinus*	25
deer / red muntjac	kijang	*Muntiacus muncak*	19
monkeys	monyet	*Macaca* spp.	19
deer	rusa	*Cervidae*	18
leaf monkey	cigak	*Semnopithecus pruinosus*	17
porcupine	landak	*Hystrix*	17
snakes	ular	*Serpentes*	16
forest chicken	ayam hutan	*Gallus gallus*	15
cobra	kobra	*Naja sumatrana*	15
squirrel	tupai	*Callosciurus notatus*	15
mouse deer	kancil / pelanduk	*Tragulus*	12
leopard cat	kucing hutan	*Prionailurus bengalensis*	12
turtledove	balam / perkutut	*Geopelia striata*	10
crocodile	buaya	*Crocodilus* spp.	9

6.8 Fauna

In total 138 animal species (Appendix 5) were mentioned on Indonesian language or on local dialect 686 times – 95 % of species were identified: 32 bird species, 30 mammal species from which half were primates; 15 species of reptile, 4 invertebrates and 57 fish species (Table 12). From bird and land animal species 40 % were birds, 37 % mammals and 19 % of reptiles.

6.8.1 Hunting

Hunting was practiced in 17 % of households (Table 13). Forest pigs were not eaten due to religious reasons but hunted because caused problems in cultivations. Instead, porcupine, deer and birds were consumed. Birds were also hunted for pets. One contestant said that used to hunt few years ago, but not anymore, because “now has money for food”.

Table 13. Hunted animals. No. indicates number of households mentioning the species as hunted. (The animals for which the species name is not known but in local language, are indicated by a question mark.)

English name	Indonesian name	Scientific name	No.
forest pig	babi	*Sus scrofa*	4
birds	burung	*Aves*	3
mouse deer	kancil / pelanduk	*Tragulus sp.*	3
porcupine	landak	*Hystrix sp.*	3
forest chicken	ayam hutan	*Gallus gallus*	2
bird	boba	?	2
deer	rusa	*Cervidae*	2
turtledove	balam / perkutut	*Geopelia striata*	1
bird	cerocok	?	1
green jungle fowl	denak	*Gallus varius*	1
zebra dove	ketitiran	*Geopelia striata*	1
bird	payah	?	1
jambu fruit dove	punai	*Leucotreron jambu*	1

Hunting did not have any significant statistical dependency on oil palm smallholding status, and with the economic quarter variable only barely suggestive dependence ($p \approx 0,1$): the third of the poorer quarter was hunting, 19 % of the rich, and 9 % of the middle class. Professional fishers were not hunting at all, with suggestive dependency ($p \leq 0,1$).

6.8.2 Fishing

Fishing was practiced in 75 % of households often with traps (bubu) and nets (tangguk) mainly in the Nilo and Napo rivers, but also MM plantation ditches were mentioned (Picture 8). Fishing did not have any significant dependency on wealth, but significantly ($p \leq 0,05$) with oil palm smallholding status: 77 % of oil palm smallholding households did not practiced fishing at all. Twenty per cent of households mentioned not fishing anymore or were fishing considerably less than before, because had now more work with oil palm or rubber plots, with children or because of an old age. Some considered fishing as a hobby.

Picture 8. Canoes and other fishing utensils. From the travel album of Jani Kärkkäinen.

Table 14. Most common fish. No. indicates number of households mentioning the species.

English name	Indonesian names	Scientific name	No.
snakehead	bujuk, gabus, jalai, lompong, toman jalai, toman	*Channa* sp.	41
catfish (mystus)	baung, baung pisang, inggir-inggir, berdun	*Mystus* sp.	28
selais	selais	*Hamichilurus moonbergii*	22
catfish (clarias)	lais, lele, limbat	*Clarias* sp.	14
catfish (macrones)	ikan kuning, baung kuning, baung tunggik, ubuk	*Macrones* sp.	11
giant river catfish	tapa	*Wallago tweediei*	11

Eighteen per cent of households had recognized that availability and quantity of fishes (Table 14) was better five to ten years ago than now. Also, fish were smaller in size: “If a big fish had before girth of a leg, now more like girth of an arm”, said one contestant. One household had started to practice fish farming in artificial ponds with Lele (*Clarias melanoderma*), but not yet producing commercially. Baung (*Mystus* sp.) and Selais (*Hamichilurus moonbergii*) were good fish to sell with Rp 30 000 per kilo, smoked fish up to Rp 120 000 per kilo. Besides fish also clams, crabs, shrimps or lobsters or prawns were reported to be caught by four households mainly from rivers. Source for clams were in MM plantations ditches and swampy areas.

6.9 Timber

Almost all interviewed households were made of timber (Picture 9), but this data was not especially recorded. It was stated by many contestants that availability of timber was decreased, and that close forests had only small wood left, not good material for a construction. If in need of timber, households could acquire it indirectly (52 % of households) through lumberjacks, Sorek's market, or sawmill, or directly (42 % of households) from forests (especially river forest and forested areas of Tanjung Beringin were mentioned). From the rich the two thirds stated to get timber indirectly and one third directly from forest, whereas poorer households reported their sources close to fifty-fifty. However, any statistically significant dependencies of timber acquisition in relation to economic status or oil palm smallholding status were not obtained. Instead in relation to village location there was significant ($p \leq 0,05$) interdependence: 70 % of all mentions of direct acquisitions from forest came from Tanjung Beringin, vice versa, with indirect acquisition of timber (through market, sawmill or lumberjacks) 64 % of mentions came from Betung ($p \leq 0,05$).

Picture 9. A common Petalangan house and homestead. From the travel album of Jani Kärkkäinen.

Contemporary prise for timber in market was about Rp 1 000 000 per cubic meter (60 pieces of planks 40 x 20 x 1 cm), when it used to cost Rp 300 000 before. One contestant stated that regular house constructed from timber costs Rp 25 000 000 (1730 e) and from bricks Rp 35 000 000 (2420 e).

6.10 Firewood and food heating

Firewood was used as fuel for heating food in 97 % of households. In addition, kerosene was used in 31 %, gas in 9 % of households, and 3 % did not used firewood at all, but used instead kerosene or gas (Picture 10). Most commonly firewood was collected from surroundings (45 % of households), rubber plots (45 %) and forest (27 %). Two households mentioned also oil palm plot, they stated that leaves of oil palm could be used as firewood. Pinang jando (*Adinandra sarosanthera* Miq.) was mentioned as especially good firewood, rubber tree instead not because burning causes plenty of smoke.

Picture 10. Two different kitchens with kerosene and firewood stoves. From the travel album of Jani Kärkkäinen.

Six households needed to go up to 2 km away to the forest to get their firewood. Approximately two armfuls of firewood were used in a week per household. 48 % of households reported to own kerosene or gas stove, the rest prepared their food only on open fire. Usually also those who had a stove cooked on open fire, due to favouring flavour it was presupposed to add in food. Average expense for gas was Rp 56 000 per month, whereas for kerosene the lower quarter households used Rp 45 000 per month and the upper quarter Rp 84 000 per month.

From the lower quarter 88 % and from the upper 63 % used only firewood for heating food ($p \leq 0,05$), and when comparing with oil palm smallholding status: less than half of the oil palm smallholders were using only firewood and from non-oil palm smallholding households 81 % ($p \leq 0,01$). All gas users were oil palm smallholders ($p \leq 0,05$) and from the wealthier half of the households ($p \leq 0,01$), 25 % of the upper quarter utilised gas whereas lower quarter did not have this option at all ($p \leq 0,05$). Kerosene was more commonly used by the middle-class (75 %) than the upper quarter (15 %) or lower quarter (10 %) households ($p \leq 0,05$), but 75 % of kerosene users were oil palm smallholders ($p \leq 0,1$).

6.11 Water

All households had access to clean water, 64 % owned a well (Picture 11.) and 45 % were getting at least some part of water from a divided well, whether from village's public well or from neighbour's well. Some wells were used only for washing and bathing due to bad quality of water. Rivers or lakes were used for bathing and washing clothes more commonly in Tanjung Beringin (84 % of mentions came from the village, Picture 11.), where half of the households used them ($p \leq 0,001$). From the upper quarter of households 94 % owned wells and from the lower 56 % ($p \leq 0,05$). From the upper quarter 13 % got some part of their water from a divided well whereas more than half of the lower quarter households ($p \leq 0,01$). In line with this, from the wealthier half of households the two thirds didn't need water from divided well at all, whereas from the poorer half 56 % did ($p \leq 0,1$). There was no statistically significant connection between ownership of wells with the oil palm smallholding status.

Picture 11. A household well for drinking and a stream for washing and bathing. From the travel album of Jani Kärkkäinen.

Close to third of the households stated that at least one of their wells might dry sometimes. From the drying wells 77 % were of the poorer half of the households ($p \leq 0,01$) and 65 % from the non-oil palm smallholding households ($p \leq 0,05$).

6.12 Recreational places

Sixteen locations were mentioned (n=105) by households as recreational places. From these Sorek (n=35), Betung (n=18) and Pekanbaru (n=10) were the most common. In addition, such places as home, neighbours, river (fishing), rice field or football court was mentioned few times as an object of recreation. The eight of the locations (Bankinang, Dumai, Kuantan, Langgam, Padang, Pekanabaru, Rengat Regency and Siak Regency) were situated further than 100 km away, rest (Betung, Pangkalan Kerinchi, Kesuma, Pangkalan Lesung, Sorek, Talau, Tanjung Beringin and Ukui) in radius of 50 km. There was a significant ($p \leq 0,05$) dependency with the economic halves variable and suggesting dependence ($p \leq 0,1$) with the oil palm smallholding status variable between locations of recreation further than 100 km away: 71 % of all mentions came from the wealthier half of households and 77 % from oil palm smallholding households.

Table 15. Households' time-use in certain activities: times per month, hour per month and calculated meantime per occurrence.

Activity	times/mth	h/mth	h/times
farming rubber	23	78	3,5
farming homegarden	20	35	1,8
farming oil palm	14	60	4,3
labouring oil palm	12	101	8,5
fishing	11	63	5,5
hunting	9	-	-
collecting firewood	6	13	2,2

6.13 Time use

Rubber farming was needed to carry out practically every day excluding Sundays, whereas oil palm needed tending about three times in a week (Table 15). Homegarden needed attention at least 5 times in a week. Oil palm labourers worked in average 3 times per week, they were needed especially for weeding and cutting bunches. Fishing was practised nearly 3 times in a week by those who went to fish and hunting two times weekly. Firewood was collected usually 1 – 2 times in a week. Of gendered division of labour, one contestant said, that "generally men take care of oil palm plots and women the rubber".

6.14 Households' management problems

Pests formed the biggest problem class (Fig 17) for households including forest pigs (31 %), ants (24 %) and monkeys (16 %).

Forest pigs and monkeys caused troubles in home gardens as well as in rubber and oil palm plots, ants only in rubber plots. Pigs eat fruits of the oil palm bunches, and in rubber plots turn over the latex collecting cups. Ants disturb growth of the rubber trees and can cause dieback of whole trunks. Other pests in lesser extent mentioned were oil palm beetle, birds, maggots, rats and snakes. Leaf diseases (43 %) and mildews (26 %) in homegardens, oil palm and rubber plots, and oil palm's crown disease (14 %) were the most mentioned plant diseases. Third of the soil related problems were of soil fertility, other third steep slope of the plots, and fourth about erosion, also compaction, and

swampy soil were mentioned. Lesser extent was mentioned sometimes poor condition of roads or bridges hindering access and transportation of smallholders' products. Also lack of time and money was mentioned few times, as well as bad yields, old age, and the cumbersome nature of farmers work.

Usually fertilizers were applied only with KKPA and some independent oil palm plots, but with other crops and plots these were not applied at all, or if were, quite irregular bases (only 30 % of rubber plots were fertilized irregularly). Erosion was most often related with the KKPA's (two third of all cases) with nearly suggestive dependence ($p \approx 0{,}1$). 83 % of KKPA smallholders against 54 % of others had problems with plant diseases with significant ($p \leq 0{,}05$) dependency. Soil quality was nearly significantly ($p \approx 0{,}05$) the middle-class problem. Pests were quite evenly disturbance for the rich and the poor in every niche. Lack of money and time were predominantly problems of labourers: 80 % of mentions about time ($p \approx 0{,}1$) and money ($p \leq 0{,}1$) came from labourers.

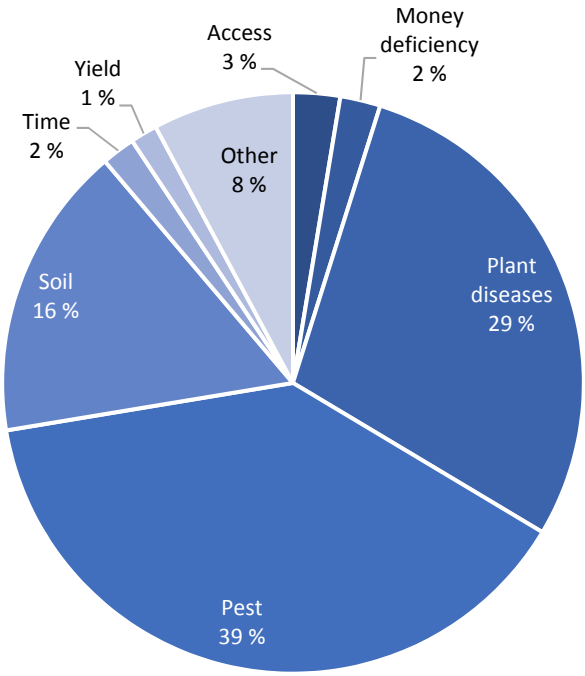

Figure 17. Distribution of the household management problems to the main problem categories. 269 household management problems were mentioned during the interviews of households.

6.15 Landscape opinions

With the open ended answers thirty-nine per cent of households mentioned landscape in a positive light, whereas 6 % thought that before the oil palm plantations the landscape was better (Figure 18). 17 % thought that less forest was better than lots of forest, though 9 % considered that there was too little amount of forest. Some contestants stated that much forest meant more wild beasts and spirits i.e. danger to the villagers, so less forest was seen as better and safer development. About trees around houses 15 % thought that it was good for shading and almost equal amount opposed current number of trees. Of the climate about 12 % thought that it was fresh and same number of contestants thought that it was too hot. For 23 % of household's a better access due to better roads was important, but 17 % thought that roads condition was not enough good. One contestant stated that sometimes there was a lot of smoke in the air from land burning far away.

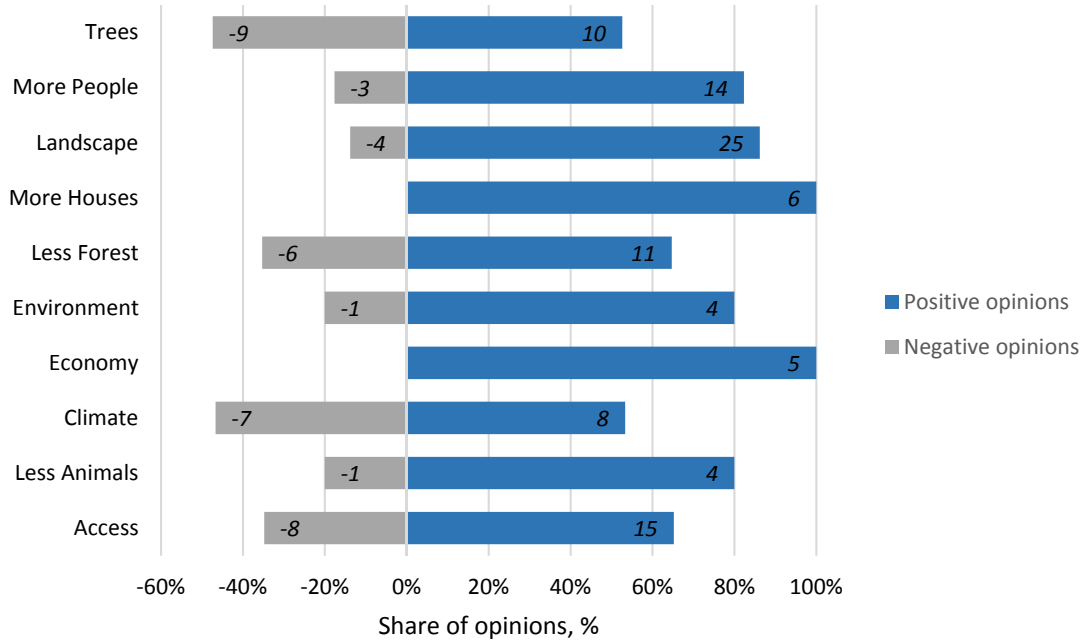

Figure 18. Households' landscape opinions divided in categories, on blue positive and on orange negative notions. Chart compares the percentage that each value contributes to a total. It shows in what proportions positive and negative opinions were given about certain issues. Altogether 155 notions were extracted from the open-ended question. Numbers in the bars signify number of opinions.

All mentions about too many trees around houses came from the oil palm smallholding households and 60 % of all mentions came from the richer half of households with significant ($p \leq 0,05$) dependency. With nearly suggesting significance ($p \approx 0,1$) 38 % of the richer quarter households, 22 % of the middle-class households and 6 % of the poor quarter households saw immigration to the village as a positive change. Altogether, 62 % of positive utilitarian notions about landscape came from the richer half of the households with nearly suggestive ($p \approx 0,1$) dependence.

6.16 Point of views about degradation of forests

Degradation of forests (n=149) was seen as a negative development by 45 %, irrelevant by 41 %, and entirely favourable by 14 % of households. With suggestive ($p \leq 0,1$) dependence 78 % of favourable mentions of forest degradation came from the richer half of households and nearly suggestively ($p \approx 0,1$) 68 % from KKPA members. Disapproval nor irrelevance were not depending on wealth or the oil palm smallholding status. The positive thing singled out in the relation to degradation of forest was its conversion to oil palm or rubber cultivation. Main negative effects mentioned relating to the degradation of forests were: loss of timber (23 % of households), firewood (20 %) and NTFPs (9 %) without any significant dependency on wealth or the oil palm smallholding status. Few raised concerns about climate change, flooding, availability of drinking water and fish, and even increased risk for natural disasters or earthquakes. Few stated also, that loss of forest would mean loss of income for some and would be especially bad for the poor. Habitat destruction was feared also because if no forest remained for wild animals, they could come to harass people in the villages. Also, if there would not be any forest left, there would not be any land for oil palm conversion to benefit villagers. Five households considered that if forest disappeared because of immigrants, it would be especially bothersome. Two households pointed out that the loss of forests would also mean loss of knowledge about animals for young generation.

6.17 Ecosystem service valuations

Quality of water, soil and landscape were teemed (see 5.3.1. for valuation scheme) good (2) by households as well as availability of water, firewood and natural medicines (Figure 19). Quality (or severity) of plant diseases and pest, and availability of timber and fish was teemed bad (3). Positive valuations of landscape had significant ($p \leq 0,05$) dependency with the economic halves variable: 84 % of the poorer half saw the landscape positively in comparison to 63 % of the richer half. Negative and positive valuations on soil quality had suggestive ($p \leq 0,1$) dependence with the economic quarter variable: all negative mentions on soil came from the lower quarter and the middle class, and 88 % of the upper quarter in comparison to the 62 % of the lower quarter valued their soils positively. Availability of timber was teemed negatively by 63 % of the upper half of the households in comparison to 38 % of the lower half with significant ($p \leq 0,05$) dependency on the economic halves variable.

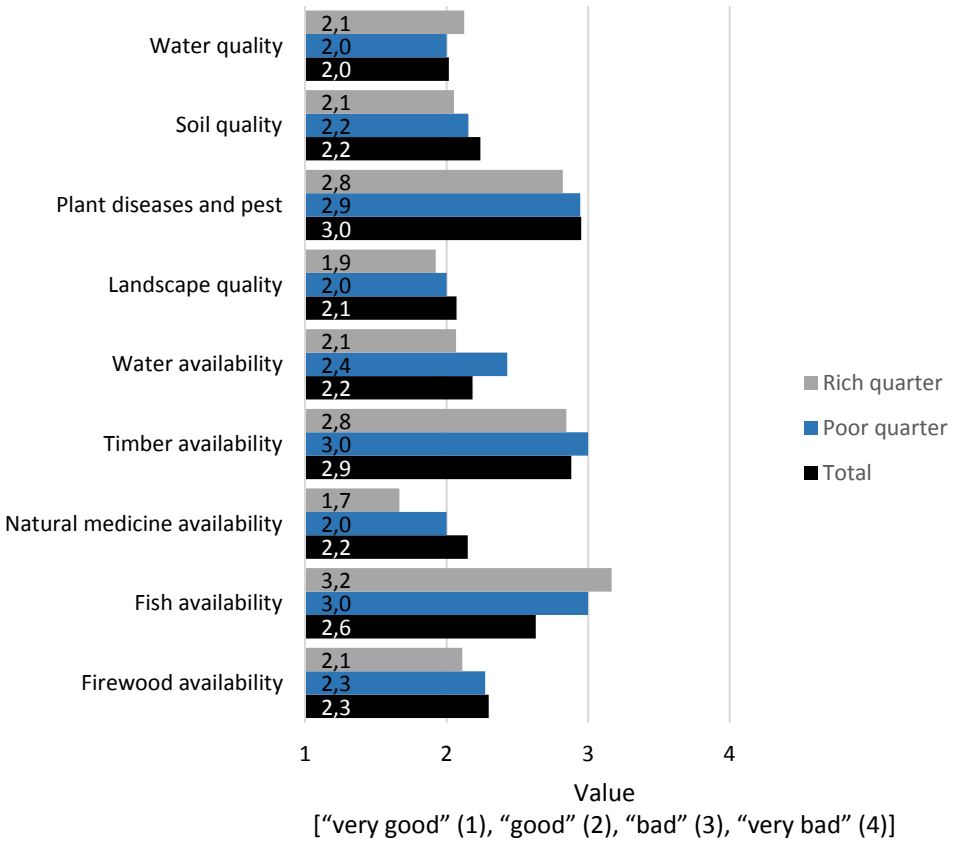

Figure 19. Households' valuations for certain ecosystem services, 465 valuation was made. Scale is from 1 to 4: "very good" (1), "good" (2), "bad" (3), "very bad" (4). Bars indicates the mean values for the rich quarter, the poor quarter and total (all households). Values on bars are the mean values.

Few contestants gave also valuations about availability of bamboo shoots (n=3: 2,7) erosion (n=11: 1,9), quality of river water (n=9; 3,0), and availability of game (n=4: 1,8)

6.18 Dangers or threats of human activities to environment

From the open-ended household answers, I identified four categories for human caused threats to the environment (n=75): waste from the mills to the rivers (23 % of households), logging (21 %), fishing with poison (17 %) and burning (2 %). With near suggestive ($p \approx 0,1$) dependence 60 % of the wealthier half of household did name one or more threats to the nature whereas 60 % of the poorer half did not name any threats.

Pt Indosawit was stated polluting the Nilo River and PT Musim Mas the Napo River. PT Musim Mas paid compensation of Rp 100 000 per household for the latest spill (five years ago) to the river.

6.19 Opinions about oil palm plantations

Based on my classification of households' opinions about the oil palm plantation industry 53 % of households felt that plantations' general impact to their life and area was positive, 23 % irrelevant, and 9 % negative (Figure 20). From the rest 15 % it was not possible discern stance about the general impact, because their answers included just some specific or singular aspects. 20 % of households mentioned specifically that the oil palm industry had positive effects to their livelihood whereas 8 % experienced difficulties due to e.g. loss of traditional income sources from forest (such as NTFPs or logging). Few stated difficulties in relation to insufficient knowledge to how to cultivate oil palm whereas some noted that agricultural extension services from the oil palm company were important to learn how to cultivate correctly. Some did not like to be so dependent on their nucleus estate but wanted possibility to sell bunches for the highest bidder. Fluctuation of palm oil prices was also named as a problem.

17 % of households gave positive notions about labouring with oil palm. It had nearly suggestive ($p \approx 0,1$) dependence on the economic quarter variable: 6 % of the rich, 16 %

of the middle class and 31 % of the poor mentioned oil palm labouring. In addition, 55 % of migrants ($p \leq 0{,}001$), 31 % of landless ($p \leq 0{,}1$), 25 % of labourers ($p \leq 0{,}1$) and 11 % of oil palm smallholders ($p \leq 0{,}1$) mentioned labouring.

44 % of households mentioned some positive, and 26 % some disapproval aspects about land use change to oil palm cultivations. There occurred suggestive ($p \leq 0{,}1$) dependency between disapproval about land use change in relation to the economic quarter variable: the richer quarter (44 %) showed most reservations, then the poor quarter (31 %) and least of all the middle class (16 %). 77 % of the negative opinions came from the Betung village ($p \leq 0{,}01$) with very significant dependency.

33 % of households mentioned that the KKPA was a positive arrangement. There was significant ($p \leq 0{,}05$) dependency between the economic quarter variable and positive opinions about the KKPA. Half of the rich and poor quarter mentioned KKPA positively, whereas from the middle class only every fifth.

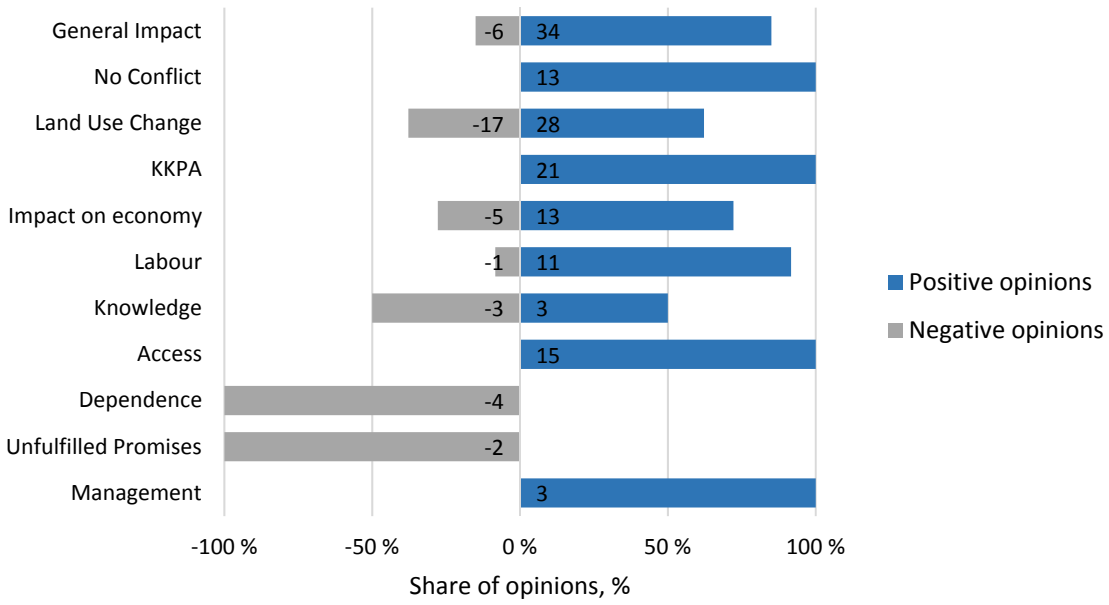

Figure 20. Households' opinions related to the oil palm plantations divided into categories, on blue positive and on orange negative notions. Chart compares the percentage that each value contributes to a total. It shows in what proportions positive and negative opinions were given about certain issues. Numbers in the bars presents number of the opinions. Altogether 285 opinions were extracted from the open-ended question.

Better access was seen as an important side-effect of oil palm development in 23 % of households. Two third of the all mentions came from the richer half of households ($p \leq 0,1$) whereas none of landless households mentioned access ($p \leq 0,05$). Some households in Tanjung Beringin stated, that MM had increased their village's security, as there were permanent guard posts on the roads leading to plantation and to the enclave area where the village situated.

6.20 Dangers or threats to human life

From the open ended household answers about the dangers and threats to human life, I identified seven categories for threats (77 threats were mentioned): diseases (34 % of contestants), robberies (31 %), homicide (5 %), earthquakes and ghosts (3 %), noise and corruption (2 %). 35 % of concerns about robberies came from the lower quarter, while only one household of the upper quarter mentioned it. There was significant ($p \leq 0,05$) dependence between the economic quarter variable and the threat for robberies. 41 % of contestants did not see any threats worth mention for human life: with nearly significant ($p \approx 0,05$) dependence 73 % of households not mentioning any threats for human life were oil palm smallholding households. Nearly suggestively ($p \approx 0,1$) 63 % of the upper quadrant, 34 % of the middle class and 31 % of the lower quadrant felt no threats for human life.

Table 16. Households' most commonly mentioned afflictions which were treated with natural remedies. No. indicates number of households mentioning cases.

Affliction	No.
fever	26
common cold	8
gastrointestinal / diarrhoea / stomach	8
anti-rheumatic	6
headache	6
muscle pain	5
mystical / magic disease / possession	5
cough	4
child birth / pregnancy	3

Twelve diseases were mentioned by households altogether 35 times: malaria (40 % of cases), diarrhoea (11 %), dengue (11 %), chicken pox (9 %), and fever (9 %). The rest were mentioned by only one household: acne, avian flu, cholera, common cold, influenza and leprosy. In the table 16 are more diseases, which were mentioned in relation to medicinal plants. Other less mentioned symptoms treated with medicinal plants were: bad appetite, back pain, diabetes, malaria, acne, sexual appetite, irritation of baby, dengue, ear and eye diseases, hypertension, impotency, influenza, liver diseases, mouthwash disease, nightmares, sore throat, sprue, toothache, weariness, and.

6.21 Aspirations for the next generation

Education (63 % of contestants), profession (33 % and often other than farmer), and generally a better life (28 %) were the most common wishes for the next generation (Picture 12).

Picture 12. The next generation. From the travel album of Jani Kärkkäinen.

There was suggestive ($p \leq 0,1$) dependence of oil palm smallholding and wealth with education: 71 % of the oil palm smallholders against the 50 % of the non-oil palm smallholding households, and 81 % of the richer quarter, 63 % of the middle class, and 44 % of the poor saw education as an important mean for the better future. In addition, were mentioned wealth, knowledge of traditions and religion, marriage, landownership and ability to take care elders.

6.22 Aspirations for future developments in the village

Infrastructure was the most mentioned development issue (Figure 21) in half of the households, second was the need for more people to the area (27 %) and the third was hopes that the Petalangan traditions could prevail and Islam could flourish (16 %). In addition, few or one households mentioned increased possibility of road accidents, tourists, and hopes that everything would stay the same. 14 % of households stated that the village could develop to district level (mainly in Betung), meaning more public services – for this purpose a bigger population was precondition. Land reform i.e. more land for oil palm and rubber development for more people was aspired by 14 % of households.

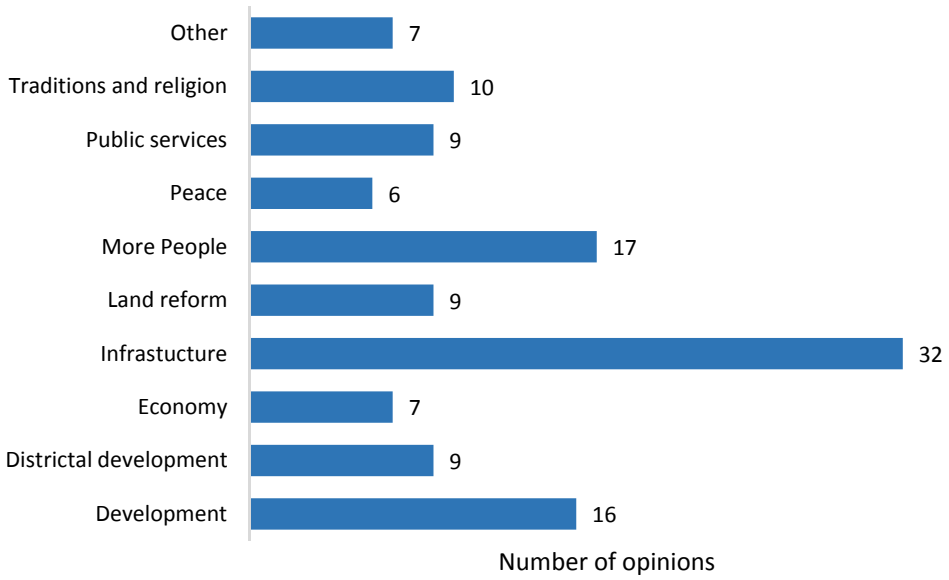

Figure 21. Households' aspirations for the near future divided in categories, 122 opinions were given by the households. Numbers in the figure represents number of households to state corresponding aspiration.

There were some concerns about emerging conflicts between the villagers (whether immigrants or indigenous) or between villagers and plantation companies and hence aspiration for enduring peace. Also, favourable economic development for the area was hoped. For the infrastructure development, paving road and electricity (in Tanjung Beringin) were the most aspired issues (23 % of households). Others less mentioned were new schools, healthcare facilities, wells, cemetery, and public transportation. Dependencies were observed with aspiration for land reform and conservation of traditions and religion. 89 % of mentions for land reform came from the poorer half of households with very significant ($p \leq 0,01$) dependency. 80 % of mentions about conservation of traditions and religion came from the non-oil palm households ($p \leq 0,01$) and 90 % from the poor quarter and the middle class ($p \leq 0,05$). Class of "development" showed suggesting ($p \leq 0,1$) dependence on oil palm smallholding: 72 % of all mentions came from oil palm smallholding households.

6.23 Development of well-being

To the question about whether households were fearing better or worse now than 5 to 10 years ago: 86 % of contestants stated that life was better, 8 % did not noted any changes, and 6 % thought that life was worse. There was suggesting ($p \leq 0,1$) dependence between oil palm smallholding and highly significant ($p \leq 0,001$) dependence between wealth (the economic halves variable) in relation to the question about quality of life (Figure 22). In addition, there was significant ($p \leq 0,05$) dependence with the economic quarter variable (Figure 23): households' unhappiness increases when their income decreases.

Income (67 % of households), access (23 %) and landownership (17 %) were the most common reasons mentioned in relation with better life. With very significant ($p \leq 0,01$) dependence with the economic quarter variable 94 % of the richer quarter, 69 % of the middle class and 44 % of the poor mentioned income. Lesser extent was mentioned regularity of income and easier livelihood from oil palm or rubber: there was no need to go far away forests collecting NTFPs, or logging or fishing for livelihood, but one could stay with family, cultivate his/hers plots and get more money than before. For some to

be able to construct own house was improvement of life (Picture 13 and 14). Few stated that to be able to consume and buy things was important. In one household better economy secured independence. Inflation (especially rising food prices), lack of fish and timber, little possibilities for recreation, and old age with loneliness was mentioned as reasons for unhappiness.

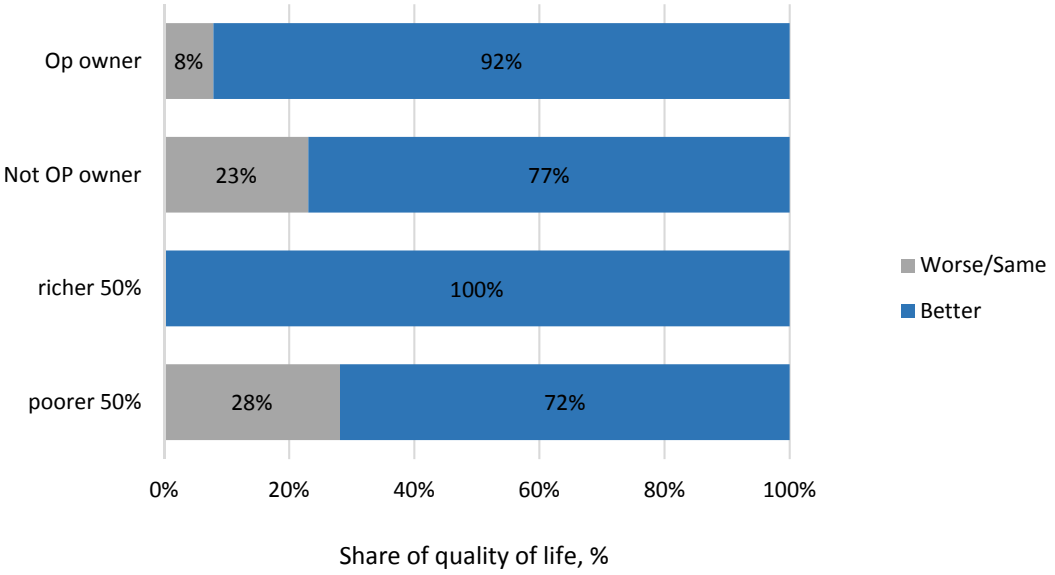

Figure 22. Interviewee's own assessment of household's quality of life in relation to ownership of an oil palm smallholding, and in relation to economic status (measured by the economic halves variable, see more in section 5.3.2 in methods).

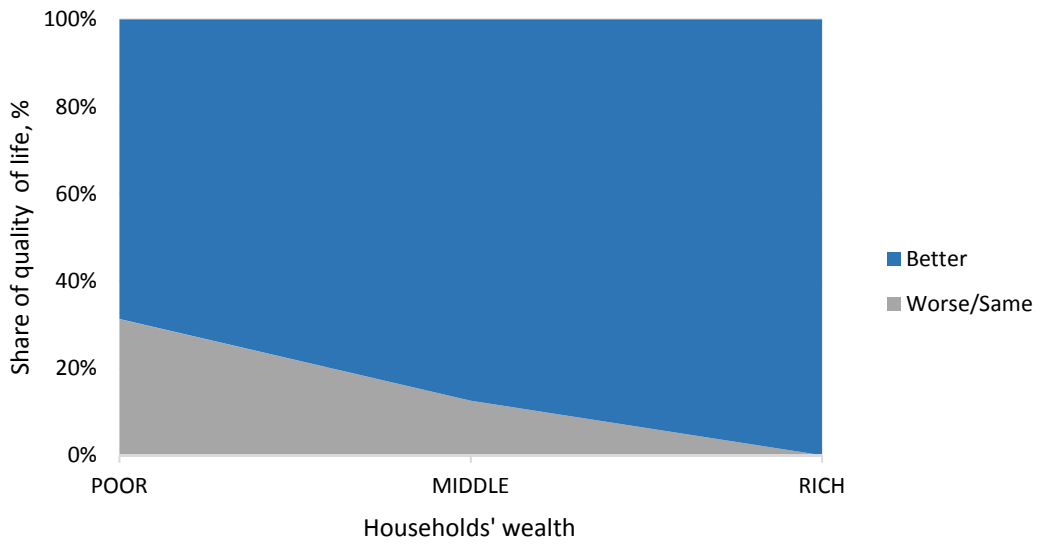

Figure 23. Interviewee's own assessment of household's quality of life in relation to economic status (measured by the economic quarter variable, see more in section 5.3.2 in methods).

Picture 13. Another house in the Tanjung Beringin village. From the travel album of Jani Kärkkäinen.

Picture 14. Another house in the Betung village. From the travel album of Jani Kärkkäinen.

7 DISCUSSION

7.1 Character and reliability of data

A common character of the interview studies (Picture 15) is that one never can be sure how complete or honest divulged information really is (Vogt 2011). Information may be partly incomplete, asymmetric and occurs in different forms, hence reconciliation and analysis have more uncertainty than e.g. with the pure governmental statistical data. Also, in my case this is true: some interviewees gave a lot of information whereas some less; although the total mass of information includes thousands of details, in some specific issues there might be only few comments; and even though interviews were semi-structured to guarantee some consistency of the data between the interviews, the data was sometimes received in different forms. Especially open-ended answers pose difficulties to statistical analysis. I have practised quantification of qualitative textual data to a numerical form. In this process some nuances and deeper insights might have been lost, which could have been identified with a more qualitative approach. There might be inconsistencies in my process of classifying data and variable creation.

Picture 15. A household and its members as objects of my interview study. From the travel album of Jani Kärkkäinen.

According to Holland and Campbell (2005) interpretative leaps form statistical analysis to conclusions are the biggest challenges of quantitative research. To alleviate this problem, I have collected secondary sources and qualitative side notes to guide the way. I discuss my data mainly in relation to wealth and oil palm smallholding status, but also in general because it depicts one case of households in an oil palm dominated agroecosystem. However, to separate effects of oil palm dominated agroecosystem to households is difficult because I don't have a control case from another ecosystem.

My data is a result of interviews through interpreters, and sometimes there were problems with the language: the Petalangan indigenous language differed from the common Indonesian language of interpreters, and translation to or from English was sometimes challenging. Also, in translation process some information might have been lost or changed. Voice recorder was not used, data was written down to the forms.

I was worried about how locals would identify me as a researcher as I was doing my research in collaboration with or at least assisted by the Pt Musim Mas: would this connection influence households' answers? My status as an independent researcher was always tried to explain to contestants, and I feel that I got rather honest answers, but there is possibility that some info was detained. I have tried to be as objective as possible without any liabilities to any third party, results in hand are my interpretations, and as such are imperfect and susceptible to a human error. Although, the Musim Mas Company offered me data, facilities and logistic solutions, it has not interfered – as far as I can fathom – to the subject matter of my research in any way. Theoretically, it is possible that the Company or some of its representatives could have been affecting to my interpreter, to give interpretations favouring the Company, but I don't have better knowledge or observation of this kind of activity. In addition, the Aksenta (2007a and 2007b) audit reports seemed to be quite objective and presenting also the negative sides of oil palm development for the environment and local inhabitants in convergence with the research in hand, and with my literature review from other sources.

I compare my results with the studies made by Aksenta (2007a and 2007b) and general statistics that I obtained from various governmental offices. The study area of Aksenta was mostly demarcated to the HGU of Musim Mas and its enclaves, whereas mine also

includes areas outside of that demarcation. Aksenta's studies show more what is the actual situation in an oil palm HGU area, whereas my results also describe areas between oil palm HGUs. It may be supposed that environment might be more degraded in the HGU area than outside of it. I also refer other studies, mainly Feintrenie et al. (2010), McCarthy (2010) and Rist et al. (2010) as well as MA (2003).

7.2 About households

Interviewed households represent 21 % of households in Tanjung Beringin and 12 % in Betung (Appendix 3). Complete randomization of households was not always possible due to time constrains, and some households interviewed were selected on the fly. Composition of interviewed households might not directly reflect households' natural composition with the normal distribution in the study villages, because I was trying to form three even sized groups according to the categories of "KKPA oil palm smallholder", "independent oil palm smallholder" and "the poor". My sampling might overemphasize differences between wealthier and poorer households since oil palm smallholders were from the richer strata of villagers and the RTM households (See more in 5.3 Methodological settings) were from the poorer end. On the other hand, my sampling depicts a continuum from the wealthy to the poor which corresponds with the idea of the Millennium ecosystem assessment (MA 2003) where well-being and poverty are "the two opposites of the same continuum". My material might be quite fitting for studying well-being, because when it emphasises the two ends of the poverty-well-being-continuum it may highlight its characteristics and different effects more pronouncedly. Roughly half of the households interviewed were oil palm smallholders, forming the wealthier half of the households.

Major part of households interviewed were of the indigenous Petalangan ethnic – although probably emphasising the wealthier part of that ethnic. Almost all households from the wealthier half were indigenous, and from the upper quarter all but one. They are an example of an indigenous group that used to be very depended on their environment and its ecosystem services (Chou 2006) but have later got used to the commercial crop culture, first with rubber, and more recently with oil palm (Effendy,

1997). Still it was visible that some marks of more stationary way of life as growing vegetables or animal keeping were not yet common part of their culture. Of their former lifestyle fishing was still predominantly preserved, but NTFPs collection and utilisation was more and more left aside. From fisher-gatherers whom the forest used to be like soul to the body they had largely changed to smallholders more depending on their crops than wildcrafting. They are an example of indigenous population facing an agrarian transition as described by Feintrenie et al. (2010) and McCarthy (2010). Though, I think that not only commercial crop smallholding and consequent wealth, but also the degradation of their environment had together been affecting abandonment of their traditional forest-based livelihoods: according to village profiles (Appendix 3) there were altogether 120 ha of traditional forest left in the study villages. In relation to their history (Effendy, 1997) it is quite staggering notion that more than half of the indigenous households felt degradation of forests irrelevant or even a positive development. Other interesting character with the Petalangan was that whereas in many places according to Obidzinski et al. (2012) or Sayer et. al (2012) indigenous people had been left outside of the oil palm development here it was the opposite: locals were relatively wealthy smallholders whereas migrants were forming landless class of less wealthy. As McCarthy (2010) noted, KKPA schemes can yield an indigenous people favouring results. Aksenta (2007b) voiced their concerns about the Petalangan diminishing livelihoods and opportunities in relation to oil palm developments, but my results show positive tendency in livelihood and well-being changes. Also households' experience of their well-being was generally positive.

What has happened with the Petalangan ethnic group seems to correspond with McCarthy's (2010) introduced World Bank's view that agribusiness can reduce rural poverty and increase economic benefits, but the development has not been without problems. There exist many reports and research about negative outcomes. Even within my research there were winners and losers, divergent livelihood results, and there was traces of similar developments that Rist et al. (2010) mentioned as some short-sightedly had sold their KKPA parcels or could not cultivate well. But at least for the interviewed Petalangan oil palm smallholders the decision of the national and district governments to encourage oil palm development (Effendy 1997) had alleviated their poverty.

7.3 About income generation

I observed highly significant dependency of households' income with the oil palm smallholding, insinuating that the oil palm smallholding highly significantly increased households' wealth. The analysis is based on monthly income comparisons, but some caution should be taken. Inconsistencies include unreliable answers and changing yield patterns of rubber (no yield during the rainy season) and oil palm, as well as irregularity of other income sources. Often, but not always contestants gave a range for income per a month. If the range was given, I calculated the mean and accepted that as the monthly income. However, the monthly palm oil income figures from my interviews reflects quite accurately with the official sharing reports of Musim Mas, whether this is true also with other income sources remains unknown.

Oil palm niche provided 59 % of the total monthly income of households interviewed, which is more than double of what was generated from the next profitable niche of rubber, and multiple times more than was obtained from forest. It might be difficult to define income as an ecosystem service of a certain niche, but income and livelihood were certainly drawn from these niches after an economic transaction. The oil palm smallholding households' income was 173 % more when compared to the non-oil palm smallholding households, but oil palm was not the only income source: 65 % of the oil palm smallholding households' income came from oil palm and 22 % from rubber. However, oil palm was still the highest profitable single source of income: 200 e / mth. This figure I got based on interviews is comparable to Musim Mas' sharing reports: a KKPA member received in average 190 e in a month during the year 2007 and 250 e in 2008. In comparison, the Petalangan oil palm smallholders received about half of what Bungoan clonal rubber smallholders got annually per hectare (Rist et al. 2010). However, Bungoan figures were gross figures, whereas my oil palm figures were net figures where costs of Musim Mas' management, loan and fertilizers (which were about half of the total gross revenue) were already deducted. This leads to a conclusion that the Bungoan clonal rubber tapping and Petalangan oil palm smallholding yielded similar annual income per hectare. In my results KKPA members' monthly income from oil palm was twice as big if compared with the local Petalangan rubber tapping (Picture 16). 63 % of oil palm smallholding households tapped rubber, which is not completely in line with

what Rist et al. (2010) has noted about oil palm being a complementary crop, but still rubber and oil palm were quite often base for richer households' livelihood. Independent oil palm smallholding seemed to be more challenging than the supported KKPA scheme, and therefore income was about 25 % less. Labouring was the least important source of income for the oil palm smallholders, and most important for migrants and landless, overall to the poorer households.

I consider that together oil palm and rubber can form a relatively secure and adequate livelihood for a household. As Rist et al. (2010) and Sadker et al. (2007) have noted oil palm can be a significant source of income and improved livelihood. Though, the dependence of these both crops to the mineral oil prices, and consequent price instabilities poses risks to stable income.

Picture 16. Rubber tapping. From the travel album of Jani Kärkkäinen.

There occurred a large segregation of average income between the lower and higher quarter, which is in line with McCarthy (2010) who claims that oil palm causes significant differentiation of people. However, case might not be so straightforward. Although, the difference in mean monthly income between the richer and poorer quarter was quite staggering 764 %, I cannot simplistically conclude that oil palm only increases segregation, and leaves nothing to the poor: oil palm provided 65 % of the richer and 41 % of the poorer quarter's income. If an oil palm originated income would be left out from calculations, segregation would be 413 %. In other words, whereas segregation would diminish only 46 %, wealthiest actual income would diminish 187 % and poorest 70 %. In absolute figures, this would leave the poorer quarter only 32 e/mth whereas the richer would still gain 166 e/mth. Of course, comparing situation with and without oil palm is a much more complicated ecosystemic-socio-economic equation, but simple calculation can show at least some crude tendencies between the states. For the richer quarter the income came mainly through their own smallholdings while poorer were their or oil palm companies' labourers. Altogether, oil palm seems to be quite important source of income also for the poor, though without it, segregation would be lower. Based on my results it remains unclear whether heightened income level of the poorer households may overcome uneven segregation's presumed negative effects, but it seems clear according to my research, that wealth in general has many beneficial effects to households' well-being. Hence, increasing disparity of income might not be that big problem, but ill-being and lack of resources related to low income.

Aksenta (2007b) and Rist et al (2010) stated that indigenous peoples money using could be reckless because not having experience handling it before. My study shows certainly, that there were some signs of this, e.g. selling KKPA plots before yielding age or with low price or in rapid need of cash. However, consuming patterns clearly show that wealthier households used lesser portion of their income to the consumer credits, insinuating that in general additional money was not recklessly spend but managed to some degree with a sustainable manner. With wealthier and oil palm smallholding households the livelihood was not anymore solely for subsistence, but households could use their income and assets for different ends for bettering their well-being. If a household was wealthy and smallholding oil palm, there was more chances that the percentage of income spend on food or consumer credits was lower, and vice versa, if a household was

poor and not oil palm smallholder. Also, the wealthy and oil palm smallholders had more household valuables than others, shortly said: more money, more stuff.

The effects of wealth and oil palm smallholding did not always converge statistically significant ways with every detail I tested, but as connection between these two was very strong, I consider that there still might exist some dependencies although they do not emerge in statistically significant ways. If my conclusion do not have statistically significant dependence, it is mentioned with the conclusion.

7.4 About ecosystem services

My research did not touch much of the supporting or regulating services: they are largely out of scope of my interview-based study. Regulating and supporting functions of oil palm dominated environment might be impoverished and may affect soil formation, nutrient cycling, primary production, purification of air, fresh water, and flooding. This may have negative consequences for different components of well-being (MA 2003). Oil palm industry's broader biological, physical and ecological effects to the ecosystem services can be red from the appendix 1, which includes my literature survey on these issues. However, some descriptive results or mentions related to these categories were attained about habitat provisioning and species richness; quality of landscape; quality of air; quality of soil and erosion control; quality of the household water in wells and other natural sources as rivers; and regulation of human diseases by medicinal plants. Cultural services included information about religious uses of plants, sialang trees and tangkals; and indigenous dukun institution; knowledge about nature; recreation; and traditional handcrafts. Provisioning services observed in the oil palm dominated environment were different crops, and plant and animal species for nourishment, and for handicrafts, or for source of income after economic transaction, timber for house construction and firewood as a source of energy for heating food; medicinal plants for health; and fresh water. Ecosystem services of oil palm and rubber plots were mainly their corresponding crops, though seldom some edible plant species, herbs and mushrooms were cultivated or collected. Rubber plots were considerable source of firewood for many. River ecosystems were source of fish, some mollusc, and water

mainly washing clothes or bathing, but also for drinking. Home gardens or area near houses were mainly source of different fruit varieties, whereas forested areas served medicinal and religious plants, other NTFPs, timber and firewood. Hunting was practised in forested areas, but sometimes also in other niches to fend of forest pigs and other animals considered as pests.

It might be debatable whether my research area is an example of the oil palm dominated agroecosystem. But as 76 % of total plant production area of Pelalawan Regency's were under oil palm, at least its agroecosystems can be said to be oil palm dominated. As close to 40 % of all land area was under oil palm in the district of Pangkalan Kuras it seems to form quite a large single ecosystem among others. Information dealing especially the research villages of Tanjung Beringin and Betung is uncertain, but as the first is encircled by oil palm plantation of PT Musim Mas and the second is in-between plantations I feel quite safe to state that their households represent an example of life in an oil palm dominated environment. In addition, land use maps that local village officers draw seems to confirm oil palms dominant presence in the area. Therefore, my research questions and results are valid in the oil palm dominated frame of reference.

Categorical boundaries of homestead and forested area niches were sometimes unclear. Due to facts that many households did not had any especially cultivated home gardens (excluding fruit trees), and that forested area itself was a fuzzy category including secondary forest in different stages of degradation (from thickets with some larger trees to mere fruit trees around houses), the line between these two niches was sometimes vague.

My way of assessing plant species might not give an accurate amount of species available for households, because it is not based on a vegetation mapping in the actual environment, but on an assessment of verbal utterances. However, I consider that my assessment may convey additional information about plant species' importance to the households in a way that simple calculation of plant species per area could not: "more mentioned" might mean "more important". Whereas Aksenta (2007b) stated that there was no more forest or cultivated products available for the local inhabitants, my results were less grim. Altogether 176 plant species (including commercial crops) utilised by

households were mentioned. From these almost two thirds were from the forested areas, more than third was available in homesteads, little over tenth in rubber plots and less than 5 % in oil palm plots. Based on the number of different species mentioned, my results insinuate that wealthier households had in general a better access to a greater number of plant varieties, and especially in the homegardens, which were mainly inhabited by different kind of fruit trees. A commercial crop growing and home gardening because these were less frequent in the poorer households, may explain this difference in numerical distribution of mentions. At the same time the greater portion of the wealthy than the poor considered that quantity of trees around houses was too abundant, indicating that wealthier may be less dependent of trees around houses. However, NTFPs were more frequently utilised in poorer and non-oil-palm-smallholding households, which imply that NTFP's were more important to them. My results suggest that the oil palm smallholders and the richer quarter of households were less in need of NTFP's.

Nearly half of the all plant species had some medicinal and tenth some religious features. My result contradicts with the Aksenta (2007b), which stated that local were not interested to use traditional remedies anymore: 88 % utilised medicinal plants and more than two thirds also religious plants. Though, there emerged also some opinions in line with Aksenta (2007b), which belittled their use. Religious and medicinal plant utilisation was depended on ethnicity indicating that it was more a local custom, and maybe due to this reason, shown somewhat more utilised among wealthier households. Sometimes it was difficult to differentiate between medicinal and religious use of plants: decease might be labelled as mystical or magical, but treated with herbal medicine, or cough or stomach-ache might be remedied with carrying amulet around a neck. Interviewed households valued availability of medicinal plants positively, which may imply that they did not feel their availability being endangered. Whereas it is out of scope of this study to evaluate in what degree traditional medicine supports locals' health, it was certainly important part of locals' culture and surely not without health effects.

Aksenta (2007a) found 93 bird and land animal species from the Musim Mas' HGU area, from which more than half was birds, the fourth mammals, and the fifth reptiles. Species

richness was almost the same with my results, especially if excluding the fish species that they did not assessed as I did. Whereas single species mentioned were somewhat different from my results, the proportions of vertebrate classes were similar. As stated by Gasparatos et al. (2011) results points to the same conclusion that the composition of animal species in an oil palm dominated environment favours common generalist species. Hunting was rare among the households interviewed, but results suggest that the poorer households hunted more in comparison to the richer households. According to Aksenta (2007b) at least its HGU area lacked any hunting grounds. Instead, fishing was quite common, but only little less than fourth of the oil palm smallholding households fished insinuating that oil palm smallholding decreased necessity of fishing for income, subsistence as well as for amusement (Picture 17). Supposedly, oil palm farming was less time consuming, but as many oil palm smallholders had other time-consuming farming activities with e.g. rubber they might had less time for fishing. They had also more information technology gadgets for entertainment than the non-oil palm smallholding households and hence fishing was not needed that much for distraction. I think that culturally this is an important observation because it shows that the oil palm smallholding or accumulating wealth had changed their ancestral way of life of which fishing was an important part. This same pattern seems to be true also with NTFP's use.

Picture 17. A fisherman spending time in his shack. From the travel album of Jani Kärkkäinen.

Availability of fish was teemed negatively in accordance with Sheil et al. (2009) and Aksenta (2007b) due to the oil palm mils' adverse effects to the river fauna. Though, also over fishing and former bad habits for fishing with poisons as well as other changes in environment might add to the lower availability than before.

Timber was a very important natural construction material of houses. I supposed that there might have been some dependencies between the timber acquisition and wealth, but no statistical significances were revealed. Though, the pure percentage figures between higher and lower quarters might insinuate, that the wealthy acquired their timber usually indirectly from middle men whereas poorer had more tendency to get their timber directly from the forest. Availability of timber was seen negatively. Interestingly the wealthier half saw availability more negatively than the poorer half of households: maybe supply could not satisfy the higher demand of the wealthier households?

Firewood was the most common source of energy for heating food, but wealth and oil palm smallholding decreased households' dependence of firewood and increased possibility to use other food heating options, such as gas and kerosene. Availability of firewood was still valuated as good insinuating that there was not an imminent fear of disappearance of this ecosystem service for interviewees.
Wealth increased possibility of household to own a well, whereas low income predicted that household was getting its water from a divided well. In addition, wealth very significantly and oil palm smallholding significantly increased chances that a household had a non-drying well. Quality and availability of household water was teemed good by interviewees against Aksenta's (2007b) notion that at least during the dry spell there was not enough water for households.

I consider soil to be an essential asset of any farmer. According to the interviewed households the quality of soils was generally good or positive. Fertility of soil seemed to be related to households' wealth: the richer valued their soils higher than the poorer. This might be interpreted so that richer had more assets to take care of fertility of their soils. On the other hand, wealth might be also a result of a better soil conditions. Which way around this was, cannot be deducted from my data. Soil related problems were the

third biggest category mentioned by households, but their severity might be lesser since the overall quality of soils was teemed positively. Interestingly, soil quality was nearly significantly the middle-class problem maybe because the rich quarter had enough money to take care of soil fertility and from the poor quarter more than half did not had any land to be worry of.

Based on my results locals' opportunity to express recreational, cultural and spiritual values associated with ecosystems might be decreased in the oil palm dominated environment. The Petalangan people used to be very dependent of their surroundings and forest was intrinsic part of their adat-law, culture and religion, but now as forest were almost extinct, also culture related to it seemed to be changing (Effendy, 1997). It was interesting to note, that the households did not mentioned much natural or culturally important places as recreational, besides fishing and the Petalangan cultural centre in Betung. Fishing was still quite popular past time as 75 % of households practised it almost weekly. However, wealth significantly and oil palm smallholding suggestively increased peoples access to travel further a way for recreation. I consider that traditional Dukun medicine is a manifestation of local Petalangan culture and 88 % of households used it. Religious uses of plants were lesser extent reported as 40 % households mentioned them.

I have not tried to calculate economic value of different ecosystem services that oil palm dominated environment provides. Although, forests provided less than one per cent of the households' total income, economic value of their ecosystem services must still be quite significant in the form of firewood, timber, and different edible plant and animal species, and other NTFP's.

7.5 About management

Regarding monthly hours spent in a certain activity, it seems that the oil palm labouring was the most onerous activity, then the farming rubber and in the third fishing and farming oil palm. At least fifth of the KKPA owners had externalised the care of their oil palm plots to labourers for some extent. Farming oil palm was characterised more with

overseeing and managing than with the actual farmer's work. However, rubber farming required almost the twice of the attention that oil palm farming required: oil palm was harvested few times in a month whereas rubber tapping was practised almost daily during the dry season. My results are mostly in line with Rist et al. (2010) though oil palm labourers' high time use is surprise.

Households' management problems did not have much statistically significant dependence with wealth or the oil palm smallholding status. Pests were the most mentioned issue, then the plant diseases and soil related problems. Erosion was mostly problem for KKPA smallholders, probably because some KKPA areas were on steep terrain. Also plant diseases were more commonly mentioned by KKPA smallholders. From more rarely mentioned problems only the lack of time and money had any statistical dependence with other variables, namely with labouring. This is in line with my other findings that labourers needed to work more but got less money in comparison to smallholders. Labouring was mainly a livelihood method of the poorer strata of the households.

7.6 About environment

Contestants related the concept of landscape with utilitarian notions of access, economy and village development – hence more people, more houses, better roads and more income from surroundings was seen generally as positive aspects of the landscape. In contrast, such aspects of ecological degradation of nature as less forest and fewer animals were a good thing. The local micro climate was polarised issue. There were not much statistical dependencies between landscape opinions and wealth or oil palm smallholding status, but still results suggests that the wealthy households might tend to see their environment from more utilitarian point of view than their poorer counterparts. McCarthy's (2010) worries related to immigration and friction with the original inhabitants were less pointed issue with my results. Immigration was a positive landscape changing activity, as "more people and more houses" was equated with the concept of development, especially by wealthier households. Although, my results indicate that the lesser economic status might make households less welcoming for

immigrants. As with Rist et al. (2010) mixed oil palm and rubber cultivated landscape seemed to be desired state of environment for many households. In addition, my assessment of the ecosystem service valuations insinuates that households with lesser income saw landscape more positively. It seems that though the wealthier households were more approving for forest degradation they also liked less their environment.

Degradation of forest was a negative development for little less than half of the households. They related the degradation especially to the loss of ecosystem services such as timber, firewood and NTFPs. It was quite surprising that almost the same number considered degradation of forests irrelevant, considering how important source of different ecosystem services forests were or used to be. This irrelevance might have been a consequence of certain logic of thinking: if forest converted to oil palm were not theirs, it was not any benefit or concern for them, hence it was considered irrelevant for them. Somehow, they failed to recognise the interrelation of ecosystem services and forest degradation. Every sixth household considered degradation of forest entirely good thing being mainly wealthy and KKPA members indicating that wealth and KKPA membership may affect favourably on households view of forest degradation. These kinds of attitudes were also reported by Rist et al. (2010) and Feintrenie et al. (2010).
Only few significant dependencies could be observed with the valuation scheme: households with lesser income saw landscape more positively; the well-offs' soils were in better condition than that of the less wealthy.

There was no considerable variation between answers of the wealthy or poor or according to the oil palm smallholding status in relation to dangers or threats of human activities to the environment. However, results imply that the wealthier households might be more aware of environment or environmental problems meant more to them than to the poorer ones because they named more threats. All in all, quite little amount of threats was voiced, water related pollution were mentioned also by Sheil et al (2009).

According to MA (2003) institutions are vessels for stewarding ecosystem services. The Petalangan had its adat-councils, which used to direct use of natural resources according to adat law. During my interviews this tradition was still upheld, but according to the literal sources, to which my result for some degree supports, insinuates that those

traditions were degrading. This may predict degradation of remaining ecosystem services.

7.7 About oil palm industry

Majority of contestants saw the oil palm industry positively, but there was no statistically significant dependency observed between wealth or the oil palm smallholding with this issue. This may indicate that the oil palm industry was generally approved among the households interviewed. Though, according to Aksenta (2007b), Colchester et al. (2006) and others, different kinds of conflicts could be quite common to happen between oil palm companies and locals, number of households mentioning problems in my material was relatively low (9%). Labour opportunities by oil palm plantations were more important to the poor, migrants and landless, and least important for the oil palm smallholders. Surprisingly the richer quarter of households showed most reservations to the land use change for the new oil palm plantations, but this figure might be affected by bad experiences of Betung residents with the PT Bratasena, which policy seemed to include some detrimental approaches as described by Colchester et al. (2006) and to Rist et al (2010). It had opened HGU area without paying compensation to the villagers, but only to the traditional leader. The negative feedback about oil palm plantations was related mostly to PT Bratasena. There had been promises of the PT Musim Mas type of KKPA scheme, but during the time of interviews this was not yet realised. The land use change of forests to the oil palm cultivations was seen positively if it benefitted or included villagers, but negatively, if benefitted only private companies. It was also noted, that due to oil palm plantations there was not enough land to cultivate anymore.

All mentions about KKPA were positive; division of mentions according to wealth insinuates that KKPA might be seen more positively in households belonging to the richest or poorest quarters. It is unclear why only every fifth from the middle class mentioned KKPA. Better road networks by oil palm plantations resulted better access in and out from villages. Better access was more important to the wealthy. For a palm oil

producer rapid access to a mill is important for getting their products processed before they go bad.

I did not concentrate in my study on how Musim Mas' KKPA system functioned as organisation. My focus has been more in the agroecosystem level where income and ecosystem services are treated as variables in creation of well-being, whereas according to Rist et al. (2010) and Feintrenie et al. (2010) organisation and functionality of cooperative is the base for cooperatives livelihood impacts. In other words, oil palm is not automatically a stable and profitable source of income, but if cooperative is organised well, it can indeed be. This would be important aspect to research to reproduce Musim Mas' KKPA success also in other locations as McCarthy (2010) stated that the combination of distant state, weak civil society and private agribusiness could lead unsustainable results.

7.8 About life

According to households' answers about dangers or threats to human life, diseases and robberies were the most common ones. There was no statistical significance between diseases and wealth, but results with robberies indicates that the middle class and the poor were more prone to robberies or were more worried about them. Results suggest that oil palm smallholders and the wealthy felt their life safer than those who did not cultivate oil palm.

Contestants' aspirations for the next generation divulged, that education and profession were seen as gateways to a better life. It was interesting to note that while the oil palm smallholding was in many cases undoubtedly source of a higher income and better well-being, it (nor farming in general) was not the wanted profession for the descendants; instead civil servants, teacher or other formal professions were named. A better education was the most mentioned aspiration for the next generation. Result insinuates that wealth and oil palm smallholding increased household's favourable attitude to education.

Most aspired development issues for the study villages were related to a better infrastructure, higher population, and religion and traditions. The first two issues had no statistical dependency on wealth or oil palm smallholding. However, land reform and conservation of religion and traditions were more important to the poor than the wealthy. It is obvious why land reform would be more important to the poor than to the wealthy. That religion and traditions were more important to the poor could imply that wealth had been leading to a secularisation (as predicted by some theories of comparative politics) in the Petalangan community. In addition, results imply that oil palm smallholders were more inclined to favour a general development. However, when all different aspirations for future developments were joined to a one combined variable, not a single dependency was observed, which could imply that the last result is mere coincidence.

According to the Millennium Ecosystem Assessment (MA 2003) degradation of the availability and quality of ecosystem services could predict decrease in inhabitants' well-being. However, surprisingly high number (86 %) of contestants – and even more so the wealthy and oil palm smallholders – stated that their contemporary life was better from what it was five to ten years prior. Main reasons mentioned for the increase were the income, access and landownership. However, wealth was less important part of the poor's well-being meaning that their contemporary well-being depended more on NTFPs and other provisioning services. In addition, little over half of the households considered that the oil palm companies' general effect to their life was positive; more than third were irrelevant or did not had any strong stance for or against; and clear minority had felt generally negative effects, although popular image of oil palm industry could predict otherwise. Occurrence of ill-being was more common among poorer households, whereas was almost non-existent with the richer quarter of households. Results insinuates that wealth and oil palm ownership predicts positive development of the quality of life among the households I interviewed.

Based on these and other observations mentioned above, I feel encouraged to state that a livelihood providing an adequate income such as the oil palm smallholding combined with rubber tapping, results a better quality of life i.e. better well-being even in an ecosystemically degraded or impoverished environment, such as the oil palm-based

agroecosystem. Oil palm smallholding seems to strongly correspond with wealth and better well-being.

At least in short term increased wealth has been beneficial for the local Petalangan oil palm smallholding households and has benefitted also those who were not landowners themselves. However, wealth's ability to substitute various ecosystem services is limited, and trade-offs may occur if "material capital is accumulated at a cost of environmental security or cultural or spiritual values" (MA 2003). If different niches in the oil palm agroecosystem cannot be stewarded with sustainable manner, many important well-being supporting ecosystem services might fall in an utter decay. In the worst-case scenario, a higher income level from oil palm will not be able to substitute the loss of ecosystem services resulting permanent ill-being and misery for the wealthy and the poor. Against this grimmest possible image – according to my research – the oil palm-based agroecosystem was still producing well-being in the two Petalangan villages in the summer of 2008.

8 CONCLUSIONS

In this study, I have been seeking answers to the question, whether an oil palm dominated environment in general and smallholding specifically are good or bad for locals' livelihoods and well-being in the two indigenous Petalangan villages of Sumatra. How ecosystem services of the oil palm dominated environment affects households' well-being? What effects wealth and oil palm smallholding might have to well-being?

Oil palm dominated environment or oil palm agroecosystem (if understood more broadly as landscape level super ecosystem) has various ecosystem services. The state of ecosystem services in oil palm parcels or plantation areas is quite impoverished, but when oil palm dominated environment is assessed more broadly as a mosaic of different niches also more services are attained. These services have significant meanings for local inhabitants, especially to the poor and those who are not oil palm smallholders, and enhancement of this mosaic structure and remaining ecosystem services would be very important for locals' livelihood and well-being. An adequate income can overcome or substitute loss of many ecosystem services, but the total annihilation of important ecosystem services such as firewood, fresh water, natural medicines, and timber for construction among multitude of others, would have significant ill-being effects not only to the poor, but to the rich as well.

Income derived from the oil palm niche functions as a substitute for many ecosystem services degraded or lost by oil palm cultivation. Oil palm niche enhances the oil palm smallholding households' ability to access resources, to earn income, and to gain a livelihood compared to those who do not cultivate. According to my results income or wealth is a cross-cutting variable affecting to all aspects of well-being, usually with enhancing effect. Increased income and assets are base for getting enough food at-all-times, adequate shelter, and access to goods. Households without oil palm smallholdings has highly significantly lesser income, and hence fewer possibilities to substitute ecosystem services degraded or lost: higher portion of income goes to food and consumer credits leaving less assets for other ends. However, they can benefit from oil palm when labouring with smallholders or plantation companies, but with a higher

work input, loss of time, and lesser income compared to the oil palm smallholding households.

The wealthy and oil palm smallholding households have a bigger land area, their wells have a better quality; they have better access to energy (electricity as well as more options for fuel to prepare food); and better access to information technology; possibility to travel further for recreation; and more household valuables. They are less dependent of various provisioning services of their environment: NTFPs, fruit trees of homesteads, and firewood. The wealthy are more dependent on religious plants, but less on hunting; they have increased well ownership, and better quality of soils. Oil palm smallholders are less in need of fishing; their land is more prone to erosion. Wealth and oil palm smallholding do not affect to livestock ownership. Regardless of wealth or oil palm smallholding, households are equally depended of natural mushrooms, medicinal plants, and timber, and pests are quite evenly disturbance for all. All these results points to a same conclusion: higher income level decreases dependency on most ecosystem services, and/or is used for substituting degraded ecosystem services. Furthermore, with the higher income level households have more materials for good life, which helps to produce more well-being.

Wealth affects health of the households. Increased income guarantees better level of nourishment. Feeling for threats to human life occur twice less among wealthier than the poor. Wealthier has also a better and more secure access to drinking water. Wealthy's ability to have energy is enhanced in comparison to the poor. Although availability and quality of ecosystem services of oil palm dominated environment are much lower than in surroundings that are more natural, the inhabitants values the quality and availability of water, quality of soil and landscape, and availability of firewood and natural medicines positively. Whereas only the occurrence of plant diseases and pests, availability of timber and fish is evaluated negatively. Contestants do not see the oil palm dominated environment generally as a health hazard. Some even state that it is safer than the forested environment because there are no dangerous wild animals and spirits. However, wealthier households are more aware of their physical environment; see it more as a utilitarian object, but at the same time likes it less than

poorer ones. For households in an oil palm dominated environment development of the village infrastructure is more important than the degradation of forest.

I conclude that the indigenous religious institution and culture still has an important part of Petalangan life and natural remedies are available in their oil palm dominated environment. However, in the current state of their culture the households see their environment more as a utilitarian object rather than something that has some intrinsic value.

I conclude that while the oil palm smallholding increases the economic segregation of people, it also increases households' income, regardless of being rich or poor. Wealth from the oil palm smallholdings spreads further in population, beyond actual landowners in the form of salary payments to labourers. In addition, increased income makes households more tolerant or even welcoming for new incomers whereas poorer households are less tolerant.

I consider that locals' attitudes towards nature is a security threat. If the value of nature and ecosystem services is not very clear for the locals, it can increase their destruction. Wealth increases households' favourable attitude towards forest degradation. Wealthier households has more secure access to various natural and other resources than the poor e.g. energy, fresh water, land, income and ecosystem services in general. Oil palm smallholding households feel their life safer than those who do not cultivate oil palm, and the wealthy has less fears for human life than the poor. The middle-class households and the poor are more prone to robberies or are more worried about them than the wealthy. The prevalence of plant diseases and pests is directly related, and poses risks to the base of livelihood, to the income generation of smallholders. Decreased availability of timber affects directly to peoples' ability to have safe shelter as timber is important construction material. Lower availability of fish has direct effects to the household protein intake and subsistence, but also for livelihood since for some fishing is also a profession. In addition, waste from the oil palm mills, logging and fishing with poison are threats to the environment. Especially waste from the mills poses risks to quality of river water and availability of fish.

I consider that wealth increases people's freedom and ability to do choices. Possibilities of the wealthy to make decisions about their households increases, but their institutional possibilities decreases due to degradation of traditional institutions in the oil palm dominated environment. On the other hand, KKPA cooperatives are an arena of environmental education. Companies, which want to produce the RSPO certified palm oil, spreads through the agricultural extension a better practices and environmental knowledge also to the KKPA members.

It is quite clear, based on this study, that wealth and oil palm smallholding especially with the KKPA type of arrangement is very good for households' livelihood and has many positive effects to well-being (Picture 18). The KKPA system enhances especially livelihoods and well-being of local indigenous people. Wealth in general can substitute many ecosystem services of different niches. Income is the main component and major carrier of well-being. In the oil palm dominated agroecosystem poverty and non-oil-palm smallholding predicts ill-being, and vice versa, wealth and oil palm smallholding predicts well-being.

Picture 18. Another happy household. From the travel album of Jani Kärkkäinen.

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Appendix 1: Ecosystem services in oil palm agroecosystem

1. General features of oil palm stand

Oil palm is mainly cultivated in huge monocrop plantation systems, where plantation's core is the palm oil mill (Corley and Tinker 2003). There have been palm groves in Africa and Brazil varying from "secondary forest mixed with a few oil palms to almost pure stand of palms, with some small shrubs and occasional trees, and arable crops". Oil palm might still be also part of home garden systems. However, compared to the modern plantations their productivity is very low: from 0,3 – 3 t of oil/ha compared to 4 – 6 t of oil/ha with mature stands (Corley and Tinker 2003; Carter et al. 2007). Globally practices of large scale plantation industry are commonly followed around the tropics where oil palm is cultivated. Some differences prevail: Asian plantations are large, often privately owned and mills tend to be rather big, whereas South American system is more cooperation based with smaller volume. The scale of production has significant effects to the ecosystem services of oil palm dominated ecosystem. In this study, I concentrate to Asian type of oil palm plantations where smallholder schemes are applied.

Oil palm plantation development tends to completely modify natural ecosystems and habitats (Comte et al. 2012) and causes deforestation (Wicke et al. 2011). Land use change diminishes availability or removes services that were once considered obvious, but on the other hand, oil palm based agroecosystem offers other type of services that before were not reaches of the local communities and their members (Wicke et al. 2011). Areas converted have had status of natural rainforests, peat swamp forests, secondary forests, arable cropland, and other agricultural lands and waste lands. The effect of land use change differs depending on the ecosystems converted. Luskin and Potts (2011) describe shortly the phases of plantation development. First all vegetation is mechanically cleared (or fire has been used, though legally its use has been banned in Indonesia and Malaysia), then ground is terraced, roads and drainage networks are constructed, and finally oil palm seedlings are planted. Comte et al (2012) add that complete clearing of forest areas, construction of roads and drainage networks, fertilising, use of agrochemicals, waste water releases from mill and construction of other infrastructure as worker residences can change landscape level totally. After 3 – 5 years stand begins to give yield. When growing, stand goes through successive stages from "small tree phase with high solar radiation and wind exposure before the canopy closes" (Luskin and Potts 2011). Rotation starts again with the clear-cutting after 25 – 30 years when the stand has reached size to too tall to harvest and yield is diminishing.

Luskin and Potts (2011) account features of palm oil plantations, which differ significantly that of forest, and correspondingly the ability to provide ecosystem services differ too. Structurally oil palm plantations are less complex than primary forest, have shorter lifespan and causes fragmentation in landscape. Also, if riparian ecosystems close to waterways are destroyed quality of water may significantly decline (Gasparatos et al. 2011). Oil palm stands are continually managed and evenly spaced monocultures without overstory shade trees, which restrict characteristic forest habitat features to develop. Regular herbicide application maintains easy access for harvesting and prevents competition between the crop and other plants. If groundcovers (often leguminous nitrogen-fixing species) are applied erosion can be minimised and water retention ability increases. Oil palms require trimming of the fronds (palm's leaves), which are usually stacked beneath oil palms. Consequence of this is "a patchy environment of leaf litter". Again trimming "creates stubs that protrude 10-30 cm upwards from palm trunk". These "pots" collect organic matter and functions as growth medium for epiphytes in an abundant manner. There occur changes also in different phase of succession or maturity of plantation through the whole oil palm life cycle. Luskin and Potts (2011) have observed such features as microclimate conditions, amount of leaf litter and the structure, composition and complexity of the herbaceous understory and canopy. Besides age, heterogeneity on landscape level is caused by plot size and shape, and plantation management which affect such landscape-scale biological processes as connectivity, permeability and edge effects.

2. Supporting services

2.1 Biodiversity and provisioning of habitat

Ability of the ecosystem to provide habitat is a base for diversity and richness of species in the ecosystem (Foster et al. 2011). Habitat destruction has considered being most important threat to biodiversity (Gasparatos et al. 2011). Oil palm plantations have a significant impact to biodiversity in a region of biodiversity hotspots and where large portion of world's rainforests remains. More than half of the oil palm

expansion has occurred in the primary or secondary forest in Indonesia.

According to Luskin and Potts (2011) as a habitat for native forest animals or plant species the palm oil stand is not very hospitable. However, old stands can sustain more biodiversity than young stands. As a habitat oil palm stand is "strikingly" different than forests. Palm oil stand can even function as a barrier to sensitive rainforest species. Oil palm plantation contains much less species than primary forest, or even secondary logged over forest or rubber plantations (Gasparatos et al. 2011). Majority of the taxonomic groups disappear or decline in species richness and abundance if compared with primary forest: there is data at least about ants, moths, butterflies, birds, small mammals and primates (Foster et al. 2011). Oil palm expansion seems to endanger natural habitats of such exotic species than Sumatran and Bornean orang-utans, elephants, tigers and rhinos (Comte et al. 2012). On the other hand, oil palm plantation can sustain range of species, although these are usually generalists and non-forest species in no need of conservation (Gasparatos et al. 2011). There appears to be also exceptions: dung beetles, isopods, lizards and bats increases in abundance, though still decreasing in richness. Bees seem to value oil palm ecosystem since their species richness and abundance both increases when comparing to primary forest. These species are important to such ecosystem functions as nutrient cycling, predation and pollination, which might balance the oil palm agroecosystem to some extent against the loss of other species. (Foster et al. 2011). Old stands have much greater abundance of epiphytes than young stands, though in younger stands epiphyte density is higher due to shorter palm trunks (Luskin & Potts 2011). Epiphyte community is dominated by ferns; climbers are the largest and rarest species; whereas grasses are the smallest ones. The oil palm dominated landscapes tend to be less biodiverse than for example agroforestry systems within forest landscapes. Compared to arable monocrop systems oil palm still seems to be somewhat better in supporting biodiversity (Fitzherbert et al. 2008).

2.2 Land use change and deforestation

Deforestation is the most dominant form of land use change in the tropics due to urbanisation, agricultural expansion and logging (Geist and Lambin, 2002). Corley and Tinker (2003) predict that the oil palm expansion would account 2.6 % of the global forest loss. Sheil et al. (2009) discusses the knock-on effects of oil palm in relation to "infrastructure, displaced people, plantation failures, bankruptcies and timber-theft land clearance frauds" which lead greater loss of forest area than the area covered by the actual plantations. Often connection between deforestation and oil palm is totally denied in the local government or in biofuel industry. In South East Asia, the best areas for agriculture are already under cultivation or declared as nature reserves.

According to Wicke et al. (2011) in the past 30 years the Indonesian forest covered land decreased 39 Mha (130 Mha to 91 Mha), and at the same time agricultural land increased 10 Mha (from 38 Mha to 48 Mha). Wicke et al. (2011) sees that oil palm expansion has caused half of the increase on agricultural land. On national level increase of 5 Mha is relatively small compared to 39 Mha losses on forest covered land. But when 95 % of the contemporary oil palm expansion has happened in the islands of Sumatra and Kalimantan, regionally it has led to considerable stress to natural and other agricultural ecosystems (Rist et al. 2010). Ecologically significant figure is the loss of primary forest: between the years 1990 and 2005 Indonesia was losing 1.5 Mha (from 74 Mha to 49 Mha) of primary forest annually (FAO 2006). Lack of appropriate cultivation areas in Borneo and Sumatra has caused tendency to convert forests on peat soils, which account about 12 % of Indonesia's total land area (Germer & Sauerborn, 2006), while not being very good medium for oil palm due to low fertility and high moisture (Tan et al. 2007). Of Indonesian oil palm plantations 25 % are on peatlands (Tan et al. 2007). Indonesia has declared 36 million hectares of its secondary forest to be economically unproductive – major part of the oil palm expansion happens there (Corley 2008). However, these areas might have other values as wildlife habitat, and functions as watershed protection (Gressel 2008). It has been estimated that roughly 60 % of oil palm expansion in Indonesia occurred at the expense of forests (Koh & Ghazoul, 2008).

2.3 Soil formation and retention

Land use change from forest to the oil palm plantation changes considerably soil's features: top soil is extensively damaged; soil compaction and erosion occurs (Foster et al. 2011). According to Sayer et al. (2012) simplified biodiversity of soil related organisms, decreased decomposer communities and lesser amount of leaf litter leads decreased fertility. They state that compared to other agricultural crops such as soybean, maize, colza, wheat and sugarcane, oil palm agriculture can better maintain the soil quality. Water, nitrogen and energy use efficiency are far better with oil palm. Conversion may destroy natural drainage of soil and especially on low-lying areas causes waterlogging

(Obidzinski et al. 2012). Even construction of canals as remedy might not ease situation at the rainy season to convey abundant water flows.

2.4 Primary production

Standing biomass of the oil palm stand is lesser than in forest (Luskin & Potts 2011). Oil palm plantation's total vegetative standing biomass ranges between 45 t/ha and 100 t/ha with over 10 years old stands. According to Tan et al. (2009) the standing biomass in the rainforest is around 400 t/ha. Standing carbon stock of an oil palm estate ranges between 50 t/ha and 100 t/ha, in secondary forest range can be from 90 t/ha to 180 t/ha and in rainforest from 175 to 215 t/ha. Palm oil stand's annual vegetative dry matter production in Malaysia and West Africa has been 14.3 - 24.5 t/ha per year, but total dry matter production including bunches can be up to 34.1 t/ha per year (Corley & Tinker 2003). Tan et al. (2007) claim that oil palm plantation is producing annually more biomass (8.3 t/yr. compared to 5.8 t/yr.) than rainforest. For example soybean at the end of the crop period manage to produce 6 t/ha (Sayer et al. 2012). According to Luskin and Potts (2011) primary production in the form of leaf litter is higher in the older oil palm stands than younger, but understory vegetation is higher in the young stands. The percentage of bare ground, vegetation and leaf litter do not vary between young or old stands.

2.5 Water cycling

Forest clearing causes hydrological impacts (Henson 1999). Comte at al. (2012) makes various conclusions. Qualitatively, when compared mature oil palm stand to forest, different types of flows, leaching and runoff are generally increased in palm oil plantation. Infiltration and actual evapotranspiration may be similar to the forest. In tropical forest only small portion falls directly on the ground. It is assumed that lower portion of rainfall is intercepted in oil palm plantation than in tropical rainforest due to lower leaf area index. However, depending on age and form of the palm oil stand level of interception has been between 5 to 80 per cent compared to 70 to 90 per cent of the tropical rainforest. Evapotranspiration of oil palm plantation seems to be similar to the tropical rainforests (1000 – 1300 $mmyear^{-1}$). In mature rainforest about 80 to 95 per cent of rainfall may infiltrate in to the soil. Under the palm oil stand infiltrability varies considerably depending on the ground vegetation and frond piles. Soils under oil palm have often high infiltrability, but it remains low along roads, harvest pathways and weeded circles. Loss of vegetal cover and litter layer leads to reduced transpiration demand, which increases soil moisture and again leads to increased baseflow of water. On the other hand, soil compaction due to machinery leads reduced soil infiltration, which reduces sub surface flow, but increases surface runoff. Increased surface runoff causes soil erosion, higher sediment loads and nutrient losses. Furthermore, stronger stormflows cause more floods to occur. The reduced groundwater recharge decreases baseflow during the dry season. Immediately after clear cutting the hydrological features of ecosystem are most degraded. However, after transplanting oil palm soil features start to improve, not reaching the level prior to cutting, but growing gradually better.

2.6 Nutrient cycling

Comte et al. (2012) discusses nutrient cycling related to oil palm cultivation. Generally, 1 ha of tropical forest contains more nutrients in plant biomass than oil palm stand. Immature palms need more frequent fertiliser application than older ones. Application is started close to the stem when plant is young, but gradually widening fertilised area when palm grows older and develops wider root system. To avoid substantial nutrient losses fertiliser application should be avoided during the high rainfall. To be economically viable crop, oil palm requires large quantities of fertilisers to support vegetative growth and fruit production. Soils under cultivation cannot provide enough nutrients to reach economically appropriate oil bunch yields. Fertilisers account about 25 % of total palm oil production cost. However, pruned fronds can add substantially to soil nutrient stock and decrease need for chemical fertilisers. A palm oil stand yielding 30 t of fruit bunches can return annually 10 t of dry matter per hectare containing 125 kg N, 10 kg P, 147 kg K, and 15 kg Mg. Application of mulched EFB or POME can add organic matter and improve soil fertility.

According to Comte et al. (2012) nutrient cycling in oil palm ecosystem is highly depended on water cycling. Leaching losses are assumed to be high in the humid tropics due to the frequent and intense storms, high temperature and high acidity of many tropical soils. Clear cutting of forest increases nutrient losses to streams and losses are expected to be significant in oil palm plantations. However, leaching depends on the age of stand. During the initial stage actual palm biomass is lesser and does not give much protection, but abundant groundcover plants may hinder leaching. Vice versa in the later phases when the stand matures and ultimately canopy closes groundcover plants might be much decreased but the oil palm stand itself can give more

protection. Root biomass of the oil palm can reach downward up to 1 meter, but most active uptake of nutrients happens in the upper 30 cm. Shallow nutrient uptake may increase leaching. Total nutrient losses due to different causes might be 10 % from fertilisers applied, but result can vary much depending on the soil texture, the age of oil palm stand, local topography and infiltrability, and the lag time between fertiliser application and rainfall. Also, nutrient losses are dissimilar between different nutrients, for example when losses of phosphor were about 3 % of applied fertiliser, potassium losses were about twice bigger and nitrogen losses about three times higher than with phosphor.

3. Regulating services

3.1 Climate and air quality regulation

Palm oil production can affect to the climate regulation through GHG emissions in the global scale, but if local land use change is large enough also regional climate might change (Gasparatos et al. 2011). If founded on forest on mineral soils about 650 Mg carbon dioxide equivalents per hectare and on peat 1300 Mg carbon dioxide equivalents per hectare are released (Germer & Sauerborn, 2006). According to Danielsen et al. (2008) 163 t/ha of stored carbon is released to the atmosphere when rainforest is converted to the oil palm cultivation. If *Imperata* grassland is rehabilitated to oil palm plantation, 135 Mg carbon dioxide per hectare is removed from the atmosphere leading to positive carbon balance. In comparison, it would take 75 years of biofuel production to recapture initially released carbon; if fire utilised, 93 years; and if rainforest on peatland would be utilised, 692 years. According to Reijnders and Huijbregts (2008) biodiesel production could cause emission of 2.8 – 19.7 ton CO_2 equivalent per ton of palm oil. Real emissions vary greatly depending on initial land use change, actual practice of farming (fertilizer utilisation) and processing in mills including processing of waste waters and how much fossil fuels are utilised in the transportation.

Locally microclimate in plantation is generally hotter and drier than in forest, and young oil palm plantations are hotter and drier than old plantations. During the night time there is no significant difference between forest's and plantation's microclimate. Over time microclimate tends to come more buffered in an oil palm stand (Luskin & Potts 2011). Air quality regulation might be affected due to atmospheric pollutants released on various phases of palm oil production (Gasparatos et al. 2011). Use of fertilisers and land-clearing, especially with fire can release atmospheric pollutants. Oil palm plantation emits higher amount of Volatile Organic Compounds (VOCs) and nitrogen oxides than primary rainforest (Obidzinski et al. 2012). Oil palm's environmental effects can go far beyond borders of respective area. Sheil et al. (2009) conclude that there might have been connection between forest fires of Indonesia and strong El Niño phenomena in the end of 1990s. Altogether 11.6 Mha of land were burned, 0.73 ppm CO_2 was released and full cost of forest loss, degradation and smoke haze pollution was estimated worth of 5.1 – 6.3 billion dollars including cost for carbon release.

3.2 Water regulation, purification and waste treatment

Oil palm plantation has significant effects to the water ways, rivers and water regulation. Koh and Ghazoul (2008) discuss about water resources. They state that in the humid regions like in Indonesia or Malaysia the oil palm expansion does not pose a major threat for sufficiency of water. An abundant rainfall supplies usually enough water for agriculture and proper drainage is a greater concern than the irrigation or adequacy of water. However, quality of water is an issue. Conversion of forest to the palm oil plantation affects ecology of rivers. Aquatic ecosystems from rivers up to the sea and coral reefs may be affected due to intensive draining from sediment, fertilizer and herbicide flows. Neighbouring water bodies and wetlands may experience eutrophication due to runoff waters (Sheil et al. 2009) and pollution might affect functions of coral reefs as a potential long-term carbon sink (Danielsen 2008). Freshwater services might be affected by pollution. Quantity of water might be affected especially due to refining process. Quality of water might be affected due to leaching of fertilisers, pesticides and other agrochemicals, and oil mill effluent (POME) (Gasparatos et al. 2011). Use of agrochemicals in the plantations poses a potential risk for the aquatic ecosystems and hydrological functions (Comte et al. 2012). When managing oil palm plantation, from the overall environmental effects those that affect water quality might be the most frequent to happen. According to Obidzinski et al. (2012) deforestation lead to the siltation of waterways and swamps resulting decreased drinking water quality. Lack of forests makes plantation more vulnerable against flash floods, which again reduces water quality and quantity. Flash floods affected also logistics of communities since floods may cut people's access to the local markets diminishing their social and economic life.

Ahmad et al (2003) and Stichnothe and Schuchardt (2011) describe the processes related to the oil mill effluent (POME). POME is a highly polluting processing waste released from the oil refineries during the extraction of oil from bunches. It is thick brownish liquid containing high amounts of solids, oil and grease, chemical oxygen demand contents and biological oxygen demand contents. To produce one tonne of crude palm oil, five tonnes of fresh fruit bunches (FFB) and 5 - 7.5 tonnes of water are required. At the same time about 1.15 t of empty fruit bunches (EFB) and 3.25 t POME are generated. POME is usually stored in pond systems, where it releases about 27.5 kg methane per one tonne of CPO produced. Accordingly, global production of 45 Mt of palm oil generates 52 Mt of empty fruit bunches and 147 Mt of POME, while almost 340 Mt of water might be used. Some companies might release their POME directly to the rivers without any treatment (Humalisto 2006). There are various methods for treatment, the most common is the ponding system, but pollution treatment is still unsolved issue in many mills.

3.3 Erosion control

Land use change from the forested ecosystem to the plantation changes considerably the ability of soil against erosion (Corley and Tinker 2003). Oil palm plantation can decrease soil erosion hazard (Gasparatos et al. 2011), but it can be also significant cause of erosion (Hartemink 2005). Oil palm stand may protect soil, but only if founded on crop or grassland (Gasparatos et al. 2011). Obidzinski et al (2012) noted that especially in the riparian areas erosion was increased due to water flows during the rainy season. Also flash floods could damage estates significantly rendering some parts inaccessible causing delays and decreased harvest. According to Comte et al. (2012) erosion occurs also from harvest patches, roads, and on areas with steep elevation. They found out in Papua New Guinea, that per 1 hectare of plantation there occurs 50 linear meters of roads, and every 100 m of road had the potential to produce as much sediment as each hectare of actual oil palm stand. According to Hartemink (2005) in mature oil palm plantation erosion was estimated at 7.7 – 14 tonnes per hectare per year in sites in Malaysia. However, oil palm industry has been quite active to find ways to alleviate erosion: e.g. mulching and cover crops for soil (Sheil et al. 2009). Corley and Tinker (2003) add that management practices usually include use of fronds as stacked barriers against runoff waters and erosion. Furthermore, herbaceous understory vegetation can bind soil, though in older stands understory vegetation tend to get sparse or non-existent and hence it's meaning as erosion control agent decreases. In the older stands tight canopy structure can offer some protection against strong rainfall.

4. Provisioning services

4.1 Food and energy

Major provisioning service from the oil palm ecosystem is the palm oil, which can be used as food or biofuel (Gasparatos et al. 2011). Oil palm is the highest yielding oil crop with average 20 – 30 t/ha of fresh fruit bunches (FFB) per annum which turns after processing to 4 – 6 t oil per hectare (Corley & Tinker 2003). Main oil products, derived from the fruit bunch are two lipids - crude palm oil (CPO) and palm kernel oil (PKO) - and palm kernel cake (Corley 2008). The PKO production accounts for about 10 % of all palm oil produced (Basiron 2007). CPO is extracted from the orange-red mesocarp of the fruits, which contain 45 to 55 % oil. PKO is extracted from the nut of the fruit, which contain 50 % of oil. Palm kernel cake is derived from the kernels after the oil extraction. Pressed cake contains 19,5 % of protein. (Edem 2002) CPO and PKO are processed to various end products: CPO is used mainly in food while PKO in the oleochemical industry (Basiron 2007). According to Corley & Tinker (2003) palm oil is a raw material for soaps and edible household fats such as vegetable oil or margarine, non-dairy milk whiteners, but also to resins, candles, glycerol, fatty acids, inks, polishing liquids and other cosmetics and fertilizers. Cake might be used as fodder for animals. Palm wine can be distilled from sap of palm. So-called new uses include different oleochemicals, biomass and biofuel. Oleochemicals can be used for example as a base for plastics. Biomass could be used as material for paper and pulp industry, plywood, furniture etc. Biofuel refined from oil can be used in mixtures with diesel or as plain biodiesel. About 17 % of palm oil is used other ends than food (Corley 2008). As a food palm oil is oxidatively very stable resulting long shelf life. Crude palm oil is free from cholesterol and rich in antioxidants such as tocopherols, vitamin E and A, and carotenoids (500-700 mg/l) (Leong et al. 2008). Red palm oil is richest food source of carotenoids in the world. However, "most of the carotene is destroyed during the refining, bleaching and deodorisation processes, which traditionally produce the light-coloured oils preferred by most consumers" (Edem 2002).

EFB and POME are potential energy sources, POME could be used for biogas production and EFB as fuel. (Stichnothe and Schuchardt 2011) According to Basiron (2007) fruit fibres

and kernel shells are often burnt in mills' boilers to generate steam and electricity for the mill. This can reduce cost for palm oil production and improve energy efficiency of production.

4.2 Competition with other provisioning services

Palm oil production compete with other provisioning services such as fibre and timber (Gasparatos et al. 2011). Obidzinski et al. (2012) found that such forest products as timber and medicinal plants or agricultural products such as fruit trees and cassava were difficult to get after plantation appeared. Also, former agricultural practices such as rubber plantations, pineapple groves, secondary forests and fallows were often displaced. Besides replacing other cultivated plants oil palm cultivation may further on push them to other before uncultivated lands (Gasparatos et al. 2011). In a study by Obidzinski et al. (2012) oil palm plantations had significant effects to the forest cover and provisioning services gained from the forest in three different sites in Kalimantan, Papua and West Papua. In these sites, the forest cover decreased due to actual land use change and related degradation of remaining forest areas by "displacing timber-extraction activities for construction and firewood use". To collect different forest products or prepare their swiddens villagers needed to go much further away.

5. Cultural services

Gasparatos et al. (2011) discusses the land use change related effects to the cultural services. These can alter or remove cultural services (or ecosystem services which are base for some cultural services). For example, certain plants might be important ceremonial elements or high biodiversity agriculture might be source for such aesthetic and cultural value which cannot be obtained from monoculture cropping systems. "Changes in ecosystem conditions can alter the values that people derive from cultural ecosystem services" (Gasparatos et al. 2011). As oil palm stand is often founded on forest it causes deforestation and diminish the cultural value people may receive from the landscape or ecosystem when destroying habitats and displaying traditional crops. In Indonesia half of the population depends on ecosystem goods and services from forest. It is suggested that deforestation affects the indigenous people unequally. Unproductive lands may be economically sustainable option for oil palm expansion, but these are not necessarily marginal in cultural sense. Marginal lands may offer refuge for politically or economically marginalised people or may be source for such cultural and spiritual values which are not readily acknowledged.

Appendix 2: Minute details of study area

1. Swot analysis of Pangkalan Kuras District

Regional development planning agency of Pelalawan regency had made a swot-analysis of Pangkalan Kuras District (BAPPEDA 2008). Its strength compared to other districts in the area was relatively good transportation options, since important asphalted road passed through the district, and there were local river harbour in Sorek. Though, condition of smaller roads was not enough for heavier traffic, and road maintenance level was generally low. Palm oil was the major agricultural product, with annual production of 63 000 tonnes. There were also poultry production (250 000 chicken and 30 000 broilers), other livestock (470 cows and goats), and in minor scale fish production (3,26 tonnes). Economic constrains were related to the low quality of permit processes, low quality of agricultural products and low wages and an ineffective production. Also, the management ability of cooperatives and other micro business was insufficient. Price instability of palm oil was seen as a potential threat. However, area interested investors, and there were also possibilities to intensify agricultural production. Locals were eager for develop trading activities, tourism and local culture. Local government was seen rather transparent, but participation with inhabitants was seen weak, and ability to apply official development policies was low due to insufficient coordination, management and evaluation. Local or traditional authorities were not always working with the official government or they did not recognise each other's needs. However, local populace demanded better services and better local government. Available religious institutions were seen as social and cultural strengths, but existence of indigenous culture was under threat by other cultural developments. Competition of land between food production and plantation production was seen problematic. Also, low use of information technology and limited access to it was seen a threat.

2. Village potential analysis

Pelalawan regency's community empowerment agency (Badan Pemberdayaan Masyarkat Desa Kabupaten Pelalawan) made village potential analysis of Tanjung Beringin and Betung villages (Dugang 2007, BPMD 2005a, BPMD 2005b). Analysis was based on scoring of natural, human and institutional resources, and infrastructure. Tanjung Beringin's level of development was below the regency and national development grade. Betung's level of development was above the regency, but below the national grade.

3. Betung

Dugang (2007) discussed some developments in the Betung village from the point of view of official village head. He mentions Musim Mas' KKPA as a very profitable income source. KKPA development was made in two phases, first was included 82 households and later additional 85 households accounting 354 ha. To enhance self-sufficiency in food production, there had been an initiative with Pelalawan regency's agricultural department to encourage rice cultivation on the area of 300 ha. Betung was also as a centre for gabah (unhalled paddy rice separated from the stalks) production. In educational sector there were some developments due to construction and enlargement of primary school. In addition, there were a religious school for Muslim. There were hopes for the future to inaugurate also junior and senior level schools. In the provincial level only 54 per cent of the population graduated from the primary school. In infrastructure roads and electricity were important development goals. There was a project to construct access road (3 km) to the rice cultivation area and reconstruction of public road (6 km), which could enhance farmer's possibilities to transport their products and ease people's access. Village had also 150 kWh generator and 2 km of power lines. There were no good health care facilities in the village and people were dependent on traditional medicine, closest health care centre was 17 km away. For religious practise there existed four mushollahs. The village office had important functions in granting permits for the locals, which were needed for example when doing business with private companies. The village office had also one computer. There were also 5 ha garden to raise additional income for the office of value of 2 500 000 Rp monthly. Betung government had arranged neighbourhood watch type security system with cooperation with the police and military to guard peace and order in the village. Also, women empowerment was acknowledged in the form of encouraging handicraft production. Furthermore, there was neighbourhood youth association, but it was not functioning well.

4. Households

Following is based on "Pangkalan Kuras in Figutes in 2006" (BPS 2006). Major source of income in the two villages was agriculture: 90 per cent in Tanjung Beringin and 70 per cent in Betung. Stores, kiosks or accommodation provided 10 % in Tanjung Beringin and Betung. In Betung 20 per cent was getting income from other sources. Betung earned 156 000 000 Rupiah in the year 2006, from Tanjung Beringin there is no such information. In the villages functions some help for poor's, namely governments distributing programme for rice (Penerima Beras Miskin) and traditional moslem donations to poor (Penerima Zakat Fitrah). In Tanjung Beringin 35 per cent of households received rice help and 20 per cent donations, respectively in Betung 24 per cent rice and 19 per cent donations. There were 261 houses in Tanjung Beringin: 39 permanent and 222 temporary or provisional. Betung had 275 houses from witch 93 were permanent and 182 temporary. Electricity was produced with household generators where power lines were lacking. Electricity was mainly used for lighting. However, In Tanjung Beringin 15 per cent and in Betung 80 per cent of houses was in general power circuit. Almost all households utilised drilled wells for drinking water in Tanjung Beringin as well in Betung. Major source for household fuel in Tanjung Beringin was firewood (62 %) and after that kerosene (38 %). In Betung figures were opposite for this and in addition 5 per cent were utilising gas. There were 79 telephones, 206 TVs and 60 radios in Tanjung Beringin. Respectively there were 66 telephones, 127 TVs and 256 radios in Betung. Furthermore, in Tanjung Beringin there were 50 motorcycles, 3 cars and 30 boats without motor. In Betung there were 179 motorcycles, 17 cars, 3 trucks, 19 boats with motor and 49 without motor.

There were one primary school in Tanjung Beringin and two in Betung (BPS 2006). There were no official health care services present in the villages. Though, in both villages there was one midwife. In addition, in Betung there were three indigenous medicine practitioners (dukun bersalin) where as in whole of district there were altogether 42 dukuns. People has some cultural practices in the Betung village, 9 groups were participating whether acting, dancing or music, but not in Tanjung Beringin. People were playing soccer and volleyball in both villages and in addition in Betung badminton, table tennis, chess and martial arts. In Tanjung Beringin there were 3 mosques (masjid), whereas in Betung 2 mosques and 6 mushollas. Muslims formed biggest religious groups in villages, 85 per cent in Tanjung Beringin and 99 per cent in Betung, rest being Christians. In 2006 there were two robberies in Tanjung Beringin and 4 in Betung, there were altogether 71 robberies in the district. (BPS 2006).

Appendix 3: Village profiles (BPMD, 2005a and 2005b)

Natural resources		TB*	Betung
		Area (ha)	Area (ha)
Wet Rice Field Land	with Cistern	-	100
Dry land	unirigated agriculture field	-	50
	housing	8	800
Wet Land	Swamp	40	2 000
Plantation Land	Society plantation	90,2	1 500,0
	Private Company	157,8	4 000,0
Forestry land	Conservation	20	-
	Producing forest	4 532	-
	Convertion land	30	-
Land for public facility	Village Treasure (kas desa)	5	5
	Field (sport)	1	2
	Gov't office	-	0,5
	Others	-	0,5

Agriculture		TB*	Betung
		Area (ha)	Area (ha)
Crops/Food plant	Maize	1	0,5
	Peanut	-	0,5
	Legume	0,5	0,5
	Rice	-	10,0
	Chili	-	0,5
	Tomato	-	0,25
	Cucumber	-	0,5
Herbal Plants	Jahe (ginger)	-	0,5
	Kunyit (Turmeric)	-	0,5
	Lengkuas (The galangale)	-	0,5
Fruits	Orange	1,5	0,5
	Avocado	0,1	-
	Mango	1,0	2,0
	Rambutan	0,1	2,0
	Mangosteen	0,03	0,50
	Papaya	-	0,5
	Starfruit	0,04	-
	Durian	0,9	1,0
	Sapodilla	0,5	-
	Lanseh tree	0,1	-
	Banana	5,04	30
	Water melon	-	1,0
Plantation plant	Coconut	0,2	-
	Oil Palm	20	5 350
	Rubber	70	150

Ownership of land		TB*	Betung
		Amount	Amount
Plantation land own	amount of HH has plantation	60	190
	No land	2	18
	has land (< 0.5 ha)	1	25
	0.5 - 1 ha	10	40
	> 1 ha	49	17

* TB = Tanjung Beringin

Forestry		TB	Betung
		Area (ha)	Area (ha)
Ownership	Government	-	-
	Traditional society	20	100
	Forest farmers (**perhutani**)	-	-
Forest product	Timber	-	-
	Honey	-	2000
	Rattan or Resin of certain trees (damar)	-	-

Livestock Breeding		TB	Betung
		Amount	Amount
Species	Cow	-	26
	Chicken	200	200
	Duck	6	-
	Goat	-	9

Mining Materials		TB	Betung
		Amount	Amount
Type	Sand	10	-

Water Resources		TB	Betung
Type	Sumur (digging ground)	20 unit	21 unit
	Spring Water		1
	River	4	1
	Swamp	40 Ha	*
	Lake	-	-
	Irigation	-	-
	Hot spring water	-	-

Human resources		TB	Betung
		Amount	Amount
	Male	361	508*
	Female	246	513*
	Male + female	607	809*
	Household	154	257**

* Figures based on village chiefs expose (Dugang, 2007) ** Figure based on maps received from village chief of Betung (2008)

Livelihood sources		TB	Betung
		Amount	Amount
Type	Farmer	-	263
	Farm labourer	-	75
	Labourer/entrepreneur	250	30
	Government servant	1	2
	Craftsman	-	35
	Merchant	-	8
	Livestock Breeder	1	2
	Fisherman	10	50
	Mechanic	-	-
	Honour teacher	1	
Employment	15-60 age	130	404
	Housewife	60	198
	Still school	30	66
	Employment 1,2,3	150	668

Education		TB	Betung
		Amount	Amount
	Primary school	1 unit	2 unit
	Religious School		1 unit

Communication		TB	Betung
		Amount	Amount
	Public telephone	-	-
	Post office	-	-
	TV / parabola	22 / 23 unit	135 / 25 unit

Appendix 4: Flora

English Name	Indonesian Name	Scientific Name	perHH
acacia	akasia	*Acacia*	1
jambu	jambu	*Acmella oleracea*	14
candlenut	kemiri	*Aleurites moluccana*	1
greater galangal	lengkuas	*Alpinia galanga*	4
vegetable amaranth	bayam merah	*Amaranthus gangeticus*	1
cashew	jambu mede / monyet	*Anacardium occidentale*	1
pineapple	nanas	*Ananas comosus*	9
soursop	sirsak / durian belenda	*Annona muricata*	2
agarwood	kayu gaharu	*Aquilaria*	1
dogfruit	jengkol	*Archidendron pauciflorum*	14
areca nut	pinang	*Areca catechu*	6
jackfruit	nangka	*Artocarpus heterophyllus*	14
cempedak	cempedak	*Artocarpus integer*	11
Squirrel's Jack	pudu	*Artocarpus kemando*	1
star fruit	belimbing	*Averrhoa carambola*	2
rambai	rambai	*Baccaurea motleyana*	1
bamboo	bambu	*Bambusoideae*	19
sugar beet	gula	*Beta vulgaris*	2
bougainvillea	bugenfil	*Bougainvillea*	1
cactus	kaktus	*Cactaceae*	1
angel wings	keladi	*Caladium* sp.	1
rattan	umbut	*Calamoideae*	16
ylang-ylang	kenang	Canangium odoratum	1
chili	cabai/cabe	*Capsicum* sp.	19
papaya	pepaya	*Carica papaya*	14
crêpe ginger	daun setawer	*Cheilocostus* sp.	2
lemon	jeruk asam	*Citrus × limon*	1
orange	jeruk	*Citrus × sinensis*	3
pomelo	jeruk bali	*Citrus maxima*	1
lime	jeruk limau / nipis	*Citrus* sp.	3
coconut	kelapa	*Cocos nucifera*	36
coffee	kopi	*Coffea*	1
gourd	labu manis	*Cucurbita* sp.	1
curcuma heyneana	temu giring	*Curcuma heyneana*	1
turmeric	kunyit	*Curcuma longa*	18
curcuma	bolai	*Curcuma* sp.	6
javanese ginger	temulawak	*Curcuma xanthorhiza*	2
lemongrass	serai	*Cymbopogon* sp.	4
tuba root	kalimayo	*Derris elliptica*	6
longan	sau	*Dimocarpus longan Lour.*	2
water yam	ubi	*Dioscorea alata*	1
vegetable fern	paku pakis	*Diplazium esculentum*	6
durian	durian	*Durio* spp.	26
oil palm	kelapa sawit	*Elaeis guineensis Jacq.*	42
eleiodoxa	kelubi	*Eleiodoxa conferta*	3
embelia	barang	*Embelia ribes*	3
st. thomas bean	akar belu	*Entada phaseoloides*	1
coral tree	dadapsrep leaves	*Erythrina variegata*	1
eugenia	samak	*Eugenia* spp.	1
long jack	pasak bumi	*Eurycoma longifolia*	7
batako plum	batak / tomu	*Flacourtia inermis*	1
mushroom barat	jamur barat	*Fungi*	1
inky cap	jamur paha ayama	*Fungi*	1
mushrooms	jamur	*Fungi*	9
rubber mushroom	jamur karet	*Fungi*	2
aku mushroom	jamur aku	*Fungi*	1
big mushroom	jamur kukuran	*Fungi*	8
oil palm mushroom	jamur sawit	*Fungi*	6
white mushroom	jamur putih	*Fungi*	4
false mangosteen	asam kandis	*Garcinia xanthochymus*	10
jasmin	kacapiring	*Gardenia jasminoides*	1
rubber tree	karet	*Hevea brasiliensis*	44
chinese hibiscus	kembang sepetu	*Hibiscus rosa-sinensis*	1
water spinach	kangkung	*Ipomoea aquatica*	2
jasmine	melati	*Jasminum* sp.	1
willow-leaved justicia	daun gandoruso	*Justicia Gendarusa Burm*	2
aromatic ginger	kencur / coku	*Kaempferia galanga*	17

English Name	Indonesian Name	Scientific Name	perHH
life plant	daun sedingin	*Kalanchoe pinnata*	2
calabash	labu sayur / air	*Lagenaria siceraria*	2
galingale	galing puyuh	*Languas* sp.	1
langsat	duku	*Lansium parasiticum*	2
yellow velvetleaf	genjer	*Limnocharis flava*	3
sponge gourd	gambas / petulo	*Luffa acutangula*	3
mango	manga	*Mangifera indica*	7
mango	kueni	*Mangifera sp.*	4
cassava	kasava	*Manihot esculenta*	19
sapodilla	sawo	*Manilkara zapota*	4
noni	mengkudu	*Morinda citrifolia*	2
wild banana	pisang hutan	*Musa balbisiana*	1
banana	pisang	*Musa* sp.	40
rambutan	rambutan	*Nephelium lappaceum*	31
petaling wood	kayu petaling	Ochanostachys amentacea	1
orchids	anggrek	*Orchidacea*	1
yam bean	bengkuang	*Pachyrrhizus erosus*	1
pandan / screw palm	pandan	*Pandanus amaryllifolius*	8
pandan 'rasau'	rasau	*Pandanus helicopus*	2
bitter bean	petai	*Parkia speciosa*	4
avocado	alpukat	*Persea americana*	1
ground cherry	ceplukan	*Physalis Angulata*	1
betel	sirih	*Piper betle*	9
pepper	merica	*Piper nigrum*	1
white pepper	lada putih	*Piper nigrum*	1
kabau tree	kabau	*Pithecellobium ellipticum*	2
monkeywood	jering	*Pithecellobium jiringa*	1
blume	putat	*Planchonia valida*	2
guava	biawas / jambi bivi	*Psidium guajava*	5
white rose	bunga omawar putih	*Rosa* sp.	1
rose	mawar	*Rosa* sp.	1
sugarcane	tebu	*Saccharum* sp.	3
snake fruit	salak	*Salacca zalacca*	3
katuk	daun katuk	*Sauropus androgynus*	1
scirpodendron	rumbai	*Scirpodendron ghaeri*	1
jungle garlic	kulim	*Scorodocarpus borneensis Becc.*	7
meranti	meranti bunga	*Shorea leprosula*	1
tomatoe	tomat	*Solanum lycopersicum*	1
eggplant	terung	*Solanum melongena*	6
wild eggplant	rimbang	*Solanum torvum*	2
hairy-fruited eggplant	torang asam	*Solaum ferox Linn*	1
coleus	daun ati-ati	*Solenostemon sp.*	2
spinach	palang	*Spinacia oleracia*	1
ambarella	kedongdong	*Spondias dulcis*	3
wild almond tree	daun jangkang	*Sterculia foetida*	1
tropical chestnuts	jebung	*Sterculia urceolata*	1
clove	cengkih	*Syzygium aromaticum*	1
rose apple	jambu air	*Syzygium samarangense*	4
cacao tree	kakao	*Theobroma cacao*	1
blue trumpet vine	patuk ubi	*Thunbergia laurifolia*	1
wild wnake gourd	kundu	*Trichosanthes cucumerina*	1
uncaria	gambir	*Uncaria gambir*	1
chinese long bean	kacang panjang	*Vigna unguiculata subsp. Sesquipedalis*	4
arrowleaf elephant ear	kimpul	*Xanthosoma sagittifolium*	2
ginger	jahe / lio	*Zingiber officinale*	25
asam palo puyuh	asam palo puyuh	?	1
benglai	benglai	?	1
betalo	betalo	?	2
buah manan	buah manan	?	1
bush/root grass	rumput semak	?	1
cassifier flower	bunga cassifier	?	1
cekair	cekair	?	1
chimbu wood	chimbu bukit	?	1
danan	danan	?	1
daun bao-bao	daun bao-bao	?	1
daun foto	daun foto	?	1
daun jiak	daun jiak	?	1
daun kopau	daun kopau	?	3
daun lipai	daun lipai	?	1

English Name	Indonesian Name	Scientific Name	perHH
daun osam	daun osam	?	3
daun pelange	daun pelange	?	1
daun puruk	daun puruk	?	1
douza	douza	?	1
gan tree	gan tree	?	3
jangau	jangau	?	2
jia Jia	jia jia	?	1
kait gading	kait gading	?	1
kayu ampentadung	kayu ampentadung	?	1
kayu kaduduk	kayu kaduduk	?	1
kayu mensio	kayu mensio	?	2
kayu sitan duk	kayu sitan duk	?	1
kayu tatome	kayu tatome	?	2
marpuyan	marpuyan	?	1
matoali root	akar matoali	?	1
mendahan	mendahan	?	1
modang paweh	modang paweh	?	1
mothers' wood	kayu ibu-ibu	?	1
paiyo	paiyo	?	1
palunggut	palunggut	?	3
panuhut	panuhut	?	1
pelange	pelange	?	2
powaan	powaan	?	1
rumput bujang sumalan	rumput bujang sumalan	?	1
samantung	samantung balu	?	2
seati	seati	?	1
takono	takono	?	1
tatome	tatome	?	2
tikan seratus	tikan seratus	?	1
tuben tawar	tuben tawar	?	1
umbut baye	umbut baye	?	1

Appendix 5: Fauna

Reptilia

English name	Indonesian name	Scientific name	perHH
whip snakes	ular lidi	*Ahaetulla* sp.	1
frogs	katak	*Anura*	1
turttle	byuku	*Batagur basca*	2
gold-ringed cat snake	ular tiung	*Boiga dendrophila*	1
boiga	ular kucing	*Boiga sp.*	1
crocodile	buaya	*Crocodilus* sp.	9
enhydris	ular air	*Enhydris* sp.	2
cobra	kobra	*Naja sumatrana*	15
reticulated python	ular sawah	*Phyton reticulatus*	4
python	sanca	*Pythonidae*	1
snakes	ular	*Serpentes*	16
coconut nettle caterpillar	ulat api	*Setora nitens*	1
tortoise / turtle	kura-kura	*Testudines*	2
soft-shell turtles	labi-labi	*Trionychia*	3
iguana / other big lizard	biawak	*Varanus salvator*	26

Mammalia

English name	Indonesian name	Scientific name	perHH
squirrel	tupai	*Callosciurus notatus*	15
dogs	anjing	*Canis lupus familiaris*	1
deer	rusa	*Cervidae*	18
sumatran elephant	gajah	*Elephas maximus sumatranus*	3
porcupine	landak	*Hystrix*	17
tiger / leopard	harimau	*Leopardus* sp.	7
otter	berang-berang	*Lutra sumatrana*	1
deer / red muntjac	kijang	*Muntiacus muncak*	19
mouse / rat	tikus	*Mus* sp. / *Rattus* sp.	5
civet cat	musang	*Paradoxurus* sp.	6
leobard cat	kucing hutan	*Prionailurus bengalensis*	12
forest pig	babi	*Sus scrofa*	59
tapir	tonok	*Tapirus indicus*	1
mouse deer	kancil / pelanduk	*Tragulus*	12
sun bear	beruang madu	*Ursus malayanus*	6

Primates

English name	Indonesian name	Scientific name	perHH
gibbons	ungka	*Hylobates* spp.	3
long-armed black gibbon	siamang	*Hylobates syndactylus*	1
long-tailed macaque	monyet ekor	*Macaca fascicularis*	2
monkeys	monyet	*Macaca* sp.	19
monkeys	monyet dahan	*Macaca* sp.	1
monkey / macaque	kera	*Macacus cynomolgus*	7
pigtailed monkey	beruk	*Macacus nemestrinus*	25
slow lori	kukang	*Nycticebus*	1
Sumatran orangutan	orangutan	*Pongo abelii*	1
leaf monkey	cigak	*Semnopithecus pruinosus*	17
leaf monkey	kokah	*Semnopithecus siamensis*	29
monkeys	bouk	?	5
monkeys	ebri	?	1
monkeys	kingkok	?	1
monkeys	kiva	?	2

Aves

English name	Indonesian name	Scientific name	perHH
eagle	elang	*Accipitridae*	2
birds	burung	*Aves*	7
hornbills	rangkok	*Bucerotidae*	1
stork	bangau	*Ciconiidae*	1
magpie-robins	murai	*Copsychus*	1
crow	gagak	*Corvus macrorhyncus*	2
sunda pygmy woodpecker	tukik tilik	*Dendrocopos moluccensis*	1
estrildid finches	pipit	*Estrildidae / Passeridae*	1
forest chicken	ayam hutan	*Gallus gallus*	15
Green junglefowl	denak	*Gallus varius*	4
turtledove	balam / perkutut	*Geopelia* sp.	10
zebra dow	ketitiran	*Geopelia* sp.	1
hill mynas	beo / tiung	*Gracula* sp.	2
jambu fruit dove	punai	*Leucotreron jambu*	1
long-tailed parakeet	bayan	*Palaeornis longicauda*	2
weaver-finch	burung tempua	*Ploceus* sp.	2
parrots	tanau	*Psittaculidae*	3
sooty-headed bulbul	kutilang	*Pycnonotus aurigaster*	2
owls	burung hantu	*Strigiformes*	1
quails	puyuh	*Turnix* spp.	1
	boba	?	3
	buai	?	1
	cerocok	?	2
	ebeo	?	1
	emprit	?	1
	kalau-kalau	?	1
	lembuan	?	1
	merincing	?	1
	meriwis	?	1
	moai	?	1
	payah	?	1
	selindit	?	1

Pisces

English name	Indonesian name	Scientific name	perHH
sucker barb	susubatang /semilang batang?	*Barbichtys leavis*	2
cyprinid fish	kaek / kapiek	*Barbonymus belinka*	1
malay combtail	silinca	*Belontia sp.*	4
malay combtail	kapar	*Belontia sp.*	2
giant river catfish	tapa	*Callichrous pabda / Wallago tweediei*	11
forest snakehead	lompong	*Channa sp.*	2
forest snakehead	bujuk	*Channa sp.*	1
emperor snakehead	jalai	*Channa marulioides*	8
snakehead fish	toman jalai	*Channa melanoptera*	1
snakehead fish	gabus	*Channa striata*	19
snakehead fish	toman	*Channa striata / Ophiochephalus melanosama*	10
cheilinus	mengkaik	*Cheilinus spp.*	5
walking catfish	limbat	*Clarias nieuhofi*	5
catfish	lais	*Clarias spp.*	2
catfish	lele	*Clarias melanoderma*	7
beardless barb	siban	*Cyclocheilichthys apogon*	2
common carp	mas	*Cyprinus carpio*	1
selais	selais	*Hamichilurus moonbergii*	22
hampala barb	barau	*Hampala spp.*	1
catfish	ikan kuning / baung kuning	*Hemibagrus planiceps*	15
catfish	baung tunggik	*Macrones sp*	10
catfish	ubuk	*Macrones sp.*	1
herring	toakang	*Megallops cyprinoides*	4
giant herring	bulan-bulan	*Megallops cyprinoides*	1
mollusk	batung	*Mollusca*	8
catfish	baung	*Mystus spp.*	26
catfish	baung pisang	*Mystus spp.*	1
catfish	inggir-inggir / berdun	*Mystus spp.*	1
nile tilapia	nila	*Oreochromis niloticus*	1
medaka	padi	*Oryzias latipes*	1
giant gourami	gurami	*Osphronemus goramy*	5

English name	Indonesian name	Scientific name	perHH
cyprinid fish	kelabau	*Osteochilus melanopleura*	2
arowana	keloso	*Osteoglossidae*	1
pangas catfish	patin	*Pangasius pangasius*	1
glass fish	pimping / sepimping ?	*Parachela oxygastroides*	3
blue ring angelfish	kambing-kambing	*Pomacanthus annularis*	1
bulu barb	siban	*Puntioplites bulu*	3
bulu barb	subahan	*Puntioplites bulu*	2
porthole rasbora	bade	*Rasbora cephalotaenia*	8
three spot gourami	sepat	*Trichopodus trichopterus*	2
?	gabai	?	6
?	bujam	?	1
?	gerabe	?	1
?	jiabai	?	1
?	kapa	?	1
?	kapetuk	?	1
?	kempalo	?	1
?	leleong	?	1
?	leman	?	1
?	lenca	?	1
?	pipis	?	1
?	plumping	?	1
?	popout	?	1
?	salolo	?	1
?	sobatang	?	1
?	talui	?	1

Invertebrata

English name	Indonesian name	Scientific name	perHH
clam	kerang	*Bivalvia*	1
crab	kepiting	*Brachyura*	1
shrimp / lobster	udang	*Caridae / Dendrobranchiata*	1
shrimp / prawn	minti udang	*Decapoda*	1
small shrimp	geragau udang	*Mysis sp.*	1

Appendix 6: Interview form

Date (Tanggal):
Name of the village (Nama Desa):
Group: Supported Oil Palm Smallholder/Independent Oil Palm Smallholder/Rubber Smallholder
(Group: Anggota KKPA/ Independent Smallholder (petani)/Petani Karet independent)

Name (Nama)	Family relationship (Hubungan keluarga)	Age (Umur)	Gender (Jenis kelamin)	Religion (Agama)	Ethnic group (Suku)	Education (Pendidikan terakhir)	Occupation/job (Pekerjaan	
							Primary (Utama)	Secondary (Sampingan)

Household name (KK /nama)	Ethnic (migrant?) (Suku)	Age of informant (Umur)

Valuable goods/owned facilities (Barang berharga/fasilitas yang dimiliki)				
Kind of goods (Nama barang)	**Number (unit) (Jumlah/satuan)**	**Year of buying (Tahun beli)**	**Price (Harga)**	**Remarks (Keterangan)**
1. Electricity/generator (Listrik/generator) **How much use gasoline/week?**				
2. Television/parabola (Televisi/parabola)				
3. Tape/radio (Kaset/radio)				
4. Chainsaw (Gergaji mesin)				
5. Bicycle/motorbike (Sepeda/motor)				
6. Canoe engine (Ketinting/tempel)				
7. Canoe (Perahu)				
8. Sewing machine (Mesin jahit)				
9. Car (mobil)				
10. Computer (computer)				
11.Telephone (telepon rumah)				
12. Cellular (HP)				
13. Stove (kerosene, electricity, gas)				
14. Waterpump, compressor				
Others (Lainnya)				

1. What is the marital status of household head? 1=married and living together; 2=married but spouse working away; 3=widow/widower; 4=divorced; 5=never married; 9=other, specify:	
2. How long ago was this household formed	*years*
3. How long have been living in this site/house?	*years*

A. Sources of income (Sumber pendapatan)				
1	Where your income does comes from? **Dari mana saja sumber penghasilan anda?** How big is your income? **Berapa besar pendapatan anda?**	**Source of income**	**Amount/ month**	**Amount/ yr**
		Palm oil: Rubber: Other sources:		
2	Are there any other household members, who work and earn money? If 'yes', who, what job, how much do they earn? **Apakah ada anggota keluarga lainnya yang bekerja dan menghasilkan uang? Bila ya, siapa dan apa pekerjaannya, dan berapa besar penghasilannya sebulan?**			
B. Ecosystem Services in agroecosystem level: tindakan (menjaga) ekosistem di tingkat ekosistem pertanian				
1	How many plots do you own and in what use they are now. Have you rented any plot? What is ownership of your plots? Have you sold your land? Do you have vegetable plot in your household? How far away your plot is? How old the stand is on the plot? Do you own other plots that are not in use? **Berapa kapling yang anda miliki dan digunakan untuk apa? Pernahkan anda menyewa lahan? Jenis kepemilikan lahan/kapling? Pernahkah anda menjual lahan anda? Apakah anda mempunyai lahan sayuran di pekarangan anda?**			
2	What crops are cultivated on the farm? How much you use in the hh and how much you sell?(Utilized/sold ratio in a year.) How much income generated from crops or products sold? **Jenis komoditi apa yang anda tanam di sekitar rumah? Berapa banyak yang anda konsumsi dan berapa banyak yang anda jual (kg/tahun). Berapa banyak pendapatan yang diperoleh jika menjual komoditi tersebut (untuk makanan, kayu, atau penggunaan lain.**	How much money you spend for buying food?		
3	Do somebody in your household collect any fruit from trees around your house? Do you have other uses from these trees? **Apakah anggota keluarga anda mengumpulkan buah-buahan dari pohon di sekitar rumah anda? Apakah anda mempunyai kegunaan lain dari pohon-pohon tersebut**			
4	Do somebody in your household collect something else from rubber plot than rubber? **Apakah seseorang di keluarga anda mengumpulkan produk selain karet dari kapling karet**			
5	Do somebody in your household collect something else from oil plot than bunches? **Apakah seseorang di keluarga anda mengumpulkan produk selain sawit dari kaplingan sawit**			
6	Where do you get plant material (seeds, seedlings etc.) for cultivation and has there been changes in availabilty? (availability, 1-4, excellent to bad) **Dimana anda mendapatkan bibit tanaman dan apakah ada perubahan dalam ketersediaannya?**			
7	What fertilizers, lime, pesticides, herbicides etc. you use in your farm? Where you get them? How much you use them in a month/year? How much you use money in a month/a year for these. How much they cost? **Pupuk, kapur, pestisida, herbisida, dll yang anda gunakan? Dimana anda mendapatkannya? Berapa banyak yang anda gunakan dalam sebulan/ setahun). Berapa banyak uang yang anda keluarkan untuk menggunakan**			
8	Do you use natural products in your farm with soil? E.g. leaf litter from forest? **Apakah anda menggunakan produk alami di ladang anda? Con. Sampah daun dari hutan untuk kompos?**			
9	Do you have livestock, e.g. chicken, ducks, cows, pigs, goats, etc. how many? **Apakah anda mempunyai ternak, con. Ayam, bebek, sapi, babi, kambing, dll. Berapa banyak?**			

10	Where do you get feed for stock? Do you have grazing lands? Who is responsible for feeding? **Dimana anda mendapatkan makanan untuk ternak? Apakah anda punya tanah penggembalaan? Siapa yang bertanggung jawab untuk memberi makan?**	
11	How much you use water for irrigation/watering (barrel per day/etc, unit?)? Where you obtain it? Who is doing the irrigation? **Berapa banyak air yang anda gunakan untuk pengairan (liter/hari). Dari mana anda memperolehnya? Siapa yang melakukannya?)**	
12	What is quality of your soils, fertility? How are soils in the Homegarden? How are soils in the palm oil cultivation? Can you value your soil in degree from 1 to 4 (excellent to bad) in different plots? **Bagaimana kualitas tanah anda, subur? Bagaimana keadaan tanah di kebun/ sekitar rumah? Bagaimana keadaan tanah di lahan perkebunan sawit? Dapatkan anda memberikan penilaian terhadap tanah tersebut (1-4) dalam kapling yang berbeda**	
13	Has he noted erosion in the farm? How? in Homegarden? in Oil palm plot? In rubber plot? Are some of your plots steep? (1-4, excellent to bad) **Pernahkah terjadi erosi di lahan anda? Bagaimana? Kebun pekarangan rumah, kaplingan sawit? Kapilngan karet? (1-4)**	
14	What is the situation with plant diseases or insects? in Homegarden? in Oil palm plot? (1-4, excellent to bad) **Bagaimana dengan keadaan hama dan penyakit tanaman? Di kebun? Di kaplingan sawit? (1-4)**	
15	Is there any problems related to management of your farm that you would like to mention? Can you put these problems in order by severity? **Apakah ada banyak masalah yang berkaitan dengan managemen dari lahan anda yang dapat disebutkan? Dapatkah anda mengurutkannya dari hal terpenting?**	
16	What activities your family members are practicing when taking care of farm. Who is doing what? How much time your family members are using in a week for cultivating your farm and plots? **Apa kegiatan anggota keluarga anda dalam menjaga lahan? Siapa yang melakukan dan apa yang dilakukannya? Berapa lama waktu yang digunakan anggota keluarga anda dalam mengolah lahan/ kaplingan anda?**	
C. Ecosystem Services in general ecosystem level (landscape level) tindakan ekosistem dalam tingkat ekosistem secara umum (alam luas)		
1	Do you hunt wild game? If yes, where? What species? How much you use (Consumption/week). Do you process or sell it and what prize. Do you buy wild game from market? In what prize? How is availability of wild meat now and five yrs ago?? (availability, 1-4, excellent to bad) Why? Consumption/week **Apakah anda memburu satwa? Jika ya, dimana? Hewan apa? Berapa banyak yang dikonsumsi dalam seminggu? Apakah anda mengolah atau menjualnya dan berapa harganya? Apakah anda membeli daging hewan liar dari pasar? Harga? Bagaimana ketersediaan daging hewan liar Semarang dan lima tahun yang lalu? Mengana? (konsumsi/minggu)**	
2	What wild animals you can still see in the village are? Are there some animals that you used to see before, but not anymore? **Apakah anda masih dapat melihat hewan liar di desa anda? Apakah ada hewan yang pernah anda lihat namun anda tidak lagi terlihat?**	
3	Do you fish from rivers or lakes? If yes, where? What species? How much you use (Consumption/week). Do you process or sell it? How is availability of fish now and five yrs ago? (availability, 1-4, excellent to bad) Why?	

	Apakah anda memancing di sungai atau danau? Jika ya, dimana? Nama ikan?Berapa banyak yang digunakan? Apakah anda mengolah atau menjualnya? Bagaimana dengan ketersediaan ikan sekarang dan 5 thn yang lalu. (1-4) Mengapa?	
4	Do you utilize any natural medicines? For what? If yes, where you collect, if buy, prize and how much,? Do you process or sell it? How is availability of natural medicines now and five yrs ago?? (availability, 1-4, excellent to bad) Why? Consumption/week. **Apakah anda menggunakan obat alami (herbal)? Untuk apa? Jika ya, dimana anda mendapatkannya, jika membeli, berapa harga dan berapa banyak yang anda gunakan? Apakah anda mengolah atau jmenjualnya? Bagaimana ketersediaannya sekarang dan 5 tahun sebelumnya? (1-4) . konsumsi/minggu**	
5	Do you use timber for some reason? Where you get timber? How is availability of timber now and five yrs ago? (availability, 1-4, excellent to bad) **Apakah anda menggunakan kayu hutan (rumah, kapal/perahu, dll)? Dimana anda mendapatkannya? Bagaimana engan ketersediaan kayu sekarang dan 5 tahun yang lalu (1-4)**	
6	How you heat your food?(gas, charcoal, firewood, kerosene, electricity) Where you get firewood. How much you use firewood/week. How is availability of firewood now and five yrs ago? (availability, 1-4, excellent to bad) Who is responsible for collecting firewood? **Bagaimana anda memasak makanan? (gas, arang, kayu bakar, listrik, minyak tanah) jika kayu bakar, dimana anda mendapatkan kayu bakar? Berapa banyak kayu bakar yang digunakan/ minggu. Bagaimana dengan ketersediaan kayu baker sekarang dan 5 tahun sebelumnya (1-4)? Siapa yang mengumpulkannya)**	
7	Do you or somebody in your household collect some other not mentioned natural (not cultivated) products from forest or other places? Or do you buy these from market. In what prize? **Apakah anda atau seseorang dalam keluarga anda mengumpulkan/mengambil produk alami yang tidak disebutkan dari hutan atau tempat lain? Apakah anda membelinya di pasar? Berapa harganya?**	
8	Do your family need to buy some not cultivated products which were before found in your land/ in the village? (foodstuffs / fiber / fuelwood / medicinal plant/etc.) Kapling/kebun **Apakah keluarga anda perlu membeli komoditi yang tidak ditanam/diolah, yang sebelumnya ditemukan di lahan/kaplingan desa anda?, serabut/fiber, kayu/ bahan bakar, tanaman obat)**	
9	Is there Natural Products (NTFP) that you don't get anymore? (e.g. bush meet, bamboo shoots, insects etc.) Why? **Adakah hasil hutan lain yang tidak lagi anda dapatkan? (con. Daging hewan liar, rebung, serangga) mengapa?**	
10	How far away you would be willing to travel to get these resources/products? **Seberapa jauh perjalanan anda untuk mendapatkannya?**	
11	How much you would be willing to pay in the market from these resources/products? **Berapa yang akan anda bayar di pasar?**	
12	Is there enough fresh water? And where it is obtained? Who is responsible for collecting it and how long it takes? Do you think that availability of fresh water has been changed (now/5 yrs. ago) and why? (availability, 1-4, excellent to bad) **Apakah ada cukup air bersih? Dimana anda mendaptkannya? Siapa yang melakukannya? Bagaimana ketersediaannya (1-4)**	
13	What is quality of drinking water? Can you value your drinking water in degree 1-4, excellent to bad) **Bagaimana dengan kualitas air minum (1-4)**	

14	Has pure water sources exhausted in the village area? Why? **Apakah air bersih telah habis terpakai/ langka? Mengapa**	
15	What do you like current landscape? (1-4, excellent to bad) Why? **Apakah anda suka dengan alam yang sekarang? (1-4) Mengapa?**	
16	What recreational places do you have in your village or close to the village? Have you lost recreational places in the village or vicinity? **Apa tempat rekreasi yang anda miliki di desa atau dekat dengan desa anda?Apakah anda kehilangan tempat rekreasi di desa atau sekitarnya?**	
17	Do you utilize plants, animals or other things found in nature or your plots for ornamental or religious means? (availability, 1-4, excellent to bad) **Apakah anda menggunakan tanaman, hewan atau yang lainnya yang ditemukan di alam atau kaplingan anda untuk hiasan atau sarana keagamaan? (Ketersediaan,1-4, terbaik hingga buruk)**	
D. Dangers/threats of human activities to forest (Bahaya/ancaman kegiatan manusia bagi SDH lokal)		
1	According to Bapak/Ibu which human activities can disturb or be harmful for environment? **Menurut Bapak/Ibu, kegiatan manusia apa saja yang dapat mengganggu atau merusak lingkungan?**	
E. Perceptions of local communities on dangers/threats (Persepsi masyarakat tentang bahaya)		
1	What threats there might be for human life in this village, according to Bapak/Ibu? (e.g. natural disasters,hunger, pests, always changing government regulations, etc.) **Ancaman apa yang mungkin membahayakan kehidupan manusia di desa ini menurut Bapak/Ibu? (Misalnya bencana alam, kelaparan, banjir, penyakit menular, peraturan pemerintah yang berubah, dll.)**	
F. Aspiration of local community (Aspirasi masyarakat lokal)		
1	What do you think about oil palm plantation in the village area/vicinity of village? What do you think about those smallholders who cultivate/don't cultivate oil palm? (1-4, excellent to bad) **Apa yang anda pikirkan tentang perkebunan sawit di/ sekitar desa? Apa yang anda pikirkan tentang petani lain yang mengolah/ tidak mengolah sawit? (1-4)**	
2	Is your (Bapak/Ibu) life better than five/ten years ago? Why? **Apakah kehidupan Bapak/Ibu sekarang lebih baik dari pada lima/sepuluh tahun yang lalu? Mengapa?**	
3	What future do you hope for your children/young generation? **Apa yang Bapak/Ibu harapkan terhadap anak-anak/generasi muda di masa depan?**	
4	What do you expect/predict will happen in your village in the next few months/years? **Apa yang Bapak/Ibu harapkan dan perkirakan akan terjadi pada desa ini beberapa bulan/tahun mendatang?**	
5	In case the forest is degraded or disappears, what are you (Bapak/Ibu) going to do? **Seandainya hutan ini berkurang atau habis, apa yang akan Bapak/Ibu lakukan? Bagaimana caranya agar hutan ini tidak musnah?**	